NEWSLETTER

JANUARY 1987

Fire Blight

Kherakhon

Paronpest

Feuerbrand

Bacterievuur

Feu Bacterien

Tizon de Fuego

Zaraza Ogniowa

Lafha Nareya

Vaktiriako Kapsimo

Paerebrann

Ildsot

INTERNATIONAL WORKING GROUP ON FIRE BLIGHT RESEARCH

INTERNATIONAL WORKING GROUP

ON

FIRE BLIGHT RESEARCH

NEWSLETTER

from the

Plant Protection Comission
International Society for Horticultural Science

in cooperation with

U.S. Deciduous Tree Fruit Disease Workers

and

European & Mediterranean Plant Protection Organization

JANUARY 1987

United States Department of Agriculture
Agricultural Research Service

Appalachian Fruit Research Station
Kearneysville, West Virginia, USA

Letter from the Editor

The year 1986 will go into history as the first year in which 4 new countries have "joined" the club of fire blight countries, which number has now risen to 19. In August, 1986, "Paronpest" was reported on pear and hawthorn on the south-east coast of Sweden directly opposite the Danish isle of Bornholm, where the disease has been present. That same month, "Paerebrann" was also observed in Norway (near Stavanger) only on several species of Cotoneaster. In September, fire blight was observed in Ireland (mainly near Dublin) on all 6 principal rosaceous hosts: Cotoneaster, Pyracantha, Sorbus, Crataegus, Malus and Pyrus (in order of importance). In the southern part of Europe, "vaktiriako kapsimo" (known on the Greek portion of Cyprus since 1984) was reported from Greece on the islands of Crete and Lesbos (Mytilini), mainly on pear but also on apple and hawthorn. The disease is now known officially in 12 languages. I trust that today there is little doubt in anybody's mind that the bacterium (Erwinia amylovora) is quite able to get around through any one or a combination of the various known ways of dissemination.

An up to date map of the distribution of fire blight in Europe and the Middle East was kindly furnished by Dr. Richard Grimm of the Fruit Research Station in Wadenswil, Switzerland. Also, the introductory comments on previous fire blight workshops, made by Jean-Pierre Paulin at the workshop at Cornell, are printed on the next page.

This year's newsletter will carry the abstracts of papers presented at the fourth workshop in New York (June, 1986). These will take the place of the newest references on fire blight which will be accumulated with this year's literature in the 1988 newsletter.

Please take note that our next (fifth) international workshop on fire blight will take place in Belgium in the third week of June, 1989.

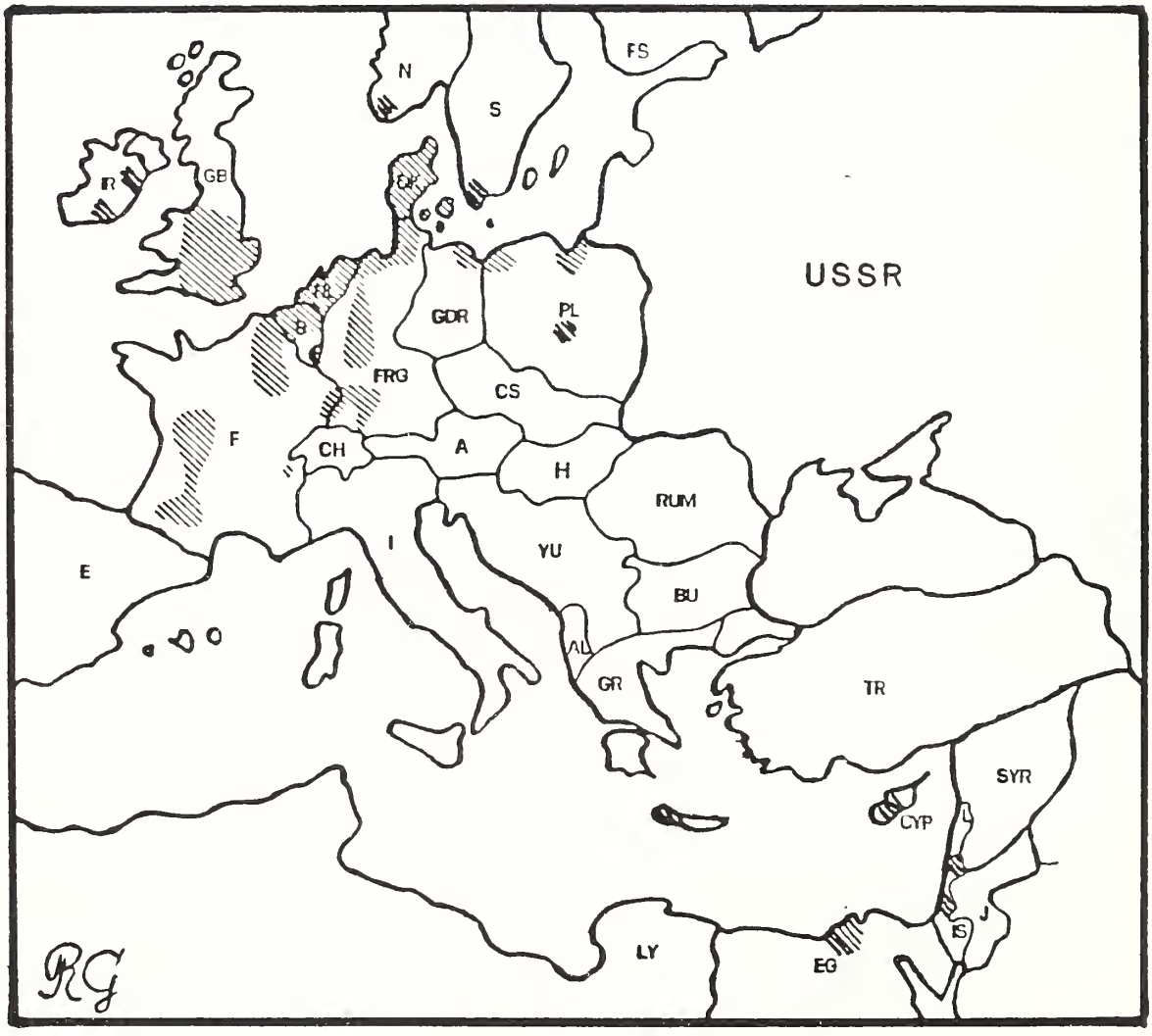
Tom van der Zwet

TOM VAN DER ZWET, Secretary
North American Section
International Working Group
on Fire Blight Research

Countries in Northwestern Europe and the Middle East

with fire blight recorded by December 1986.

Europe	Middle East
Belgium	Cyprus
Denmark	
East Germany (DDR)	Egypt
England	
France	Israel
Greece (Crete)	
Ireland	
Luxemburg	
Netherlands	
Norway	
Poland	
Sweden	
West Germany (BRD)	



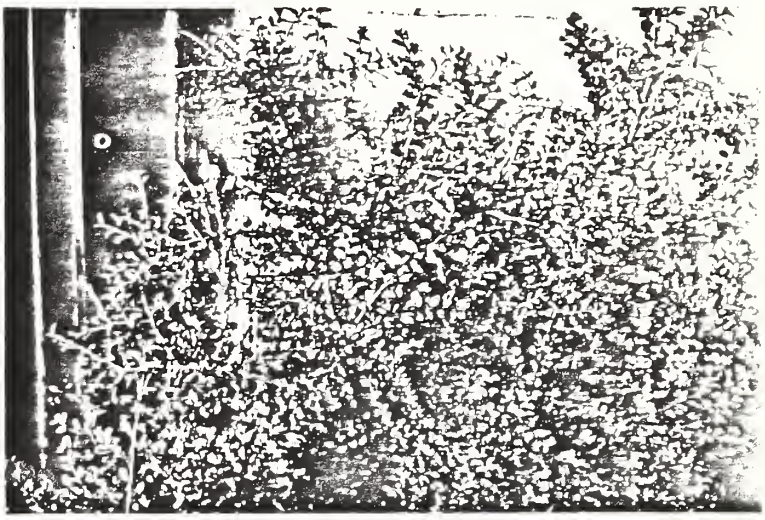
Pærebrann

Pærebrann er ein svært smittsam bakteriesjukdom som i 1986 for første gang vart oppdaga i Norge. Det var då sterke angrep på ulike artar av mispel (Cotoneaster) i Randaberg og Stavanger kommune. Angrepne planter kan visne og døy på kort tid.

Følgjande planter kan få pærebrann:

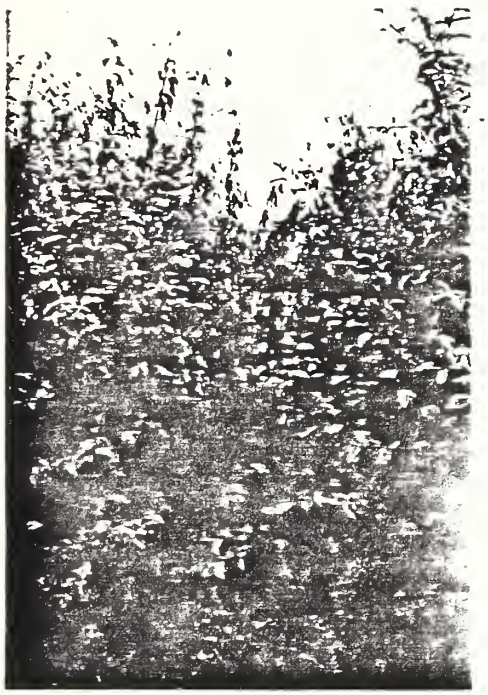
Ulike artar av mispel (Cotoneaster), hagtorn, eple, pære, eldkvede, eldtorn og asal.

Bileta viser typiske symtom på pærebrann.



Pærebrann på krypmispel (Cotoneaster horizontalis). Greina visnar inn.

(Foto: Å. Jørgensen)

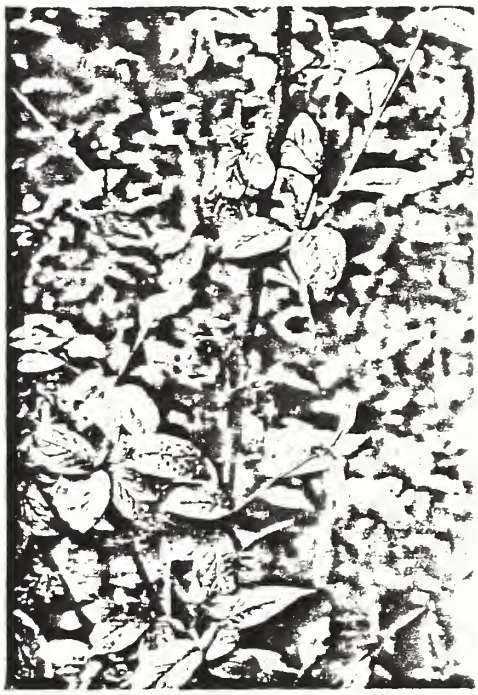


Pærebrann på bulkemispel (Cotoneaster bullatus). Angrepne busker visnar og blada blir hengande lenge på, som svidde etter brann

(Foto: A. J. Lyshol)

Skotinfeksjon — skotspissen visnar og bøyer seg i toppen.

(Foto: J. Friestad)



Blomsterinfeksjon — blomsten visnar og borken rundt infeksjonsstaden blir drepen. Seinare visnar heile greina.

(Foto: A. Sletten)

Dersom du oppdagar desse symtoma på dei planteslaga som er nemnde ovanfor, må du straks ta kontakt med Landbrukskontoret i kommunen, parketaten i kommunen, Fylkeslandbrukskontoret i Rogaland tlf. (04) 52 95 86, Statens plantevern tlf. (02) 94 94 00 eller Statens planteinspeksjon tlf. (04) 52 98 53.

Statens plantevern

Fylkeslandbrukskontoret i Rogaland

Statens planteinspeksjon

MEETINGS OF ISHS WORKING GROUP ON FIRE BLIGHT

	WAGENINGEN 1977	KIEL 1980	BORDEAUX 1983
No. of contributions	15	22	50
No. of authors	15	32	81
No. pages/proceedings	95	144	348

ACTA HORTICULTURAE: 86, 117, 151

	YEARS						
TOPICS	1978	1979	1980	1981	1982	1983	1984
Epidemiology	17	5	1	10	4	3	15
Climate	2	1	2	6	4	1	15
Microbiology	7	2	3	10	6	5	12
Genetics - Pathogenesis	5	2	5	12	2	5	9
Chemical control	19	0	4	7	8	2	16
Biological control	4	0	4	4	3	1	4
Breeding/Resistance	23	4	5	9	9	3	15

No. of publications on "Fire blight" quoted in "Fire blight newsletters"

Jean Pierre Paulin
Angers, France

PRESENT STATUS AND NEW OCCURRENCES OF FIRE BLIGHT

NORTH AMERICA

UTAH

Fire blight was serious in some young apple orchards (cv 'Rome' and 'Granny Smith') in 1986. Infections began during flowering and subsequently resulted in shoot infections. The early weather was too cold during the flowering of 'Bartlett' pears and consequently blight was rare in pears.

Treatments of streptomycin applied according to the announced high risk days resulted in satisfactory control of blight.

Sherman Thomson
Logan

GEORGIA

Georgia Coastal Plain:

During 1986, fire blight damage was minimal, being restricted to terminal growth on old trees of P. communis X oriental spp. hybrids. Middle Georgia has been relatively water-deficient for most of six years now and fire blight has been suppressed.

North Georgia Mountains:

No observations in 1986. Since I recently retired and moved to this area of the southern Appalachians, future reports will be more concerned with fire blight observations on apple selections.

Jim Thompson
Blairsville

WASHINGTON

Due to a long cold spring, fire blight on pears was very spotty and light, whereas fruit were marked up with obvious frost damage.

Ron Covey
Wenatchee

CALIFORNIA

In the Sacramento Valley, a year of low blight incidence in pears was experienced, in spite of the prediction of any early establishment of the epiphytic population of E. amylovora on the bases of both mean temperature and accumulated heat. Full bloom was two weeks ahead of normal.

In the Lake County pear district, weather was generally unfavorably cool for blight during the early spring bloom season for pears. Later apple varieties and a few very late rat-tailing pears suffered severe blight during warmer weather in the late spring, accompanied by rainfall.

Broc Zoller
Yuba City

ILLINOIS

Severe blight in southern Illinois. Unusual because it was mostly blossom blight. As many as 700 strikes/tree on 'Jonathan' and 20/tree on 'Red Delicious'. Most severe and widespread blight since I came to Illinois in 1973.

Steve Ries
Urbana

WEST VIRGINIA

Fire blight was not a severe problem in 1986. Weather conditions were slightly less than borderline. Some fire blight occurred on 'Jonathan', a susceptible variety of apples.

Joe Barrat
Kearneysville

PENNSYLVANIA

Fire blight was a problem in some Pennsylvania apple orchards in 1986 and the research orchard at Rock Springs as well. Cultivars most generally affected at Rock Springs were mature trees of 'Jonathan', 'Nittany', 'Tydeman's Red', 'N. Spy' and 'York', and young trees of 'Jerseymac', 'Gala', 'Paulared', 'Golden Delicious', and 'McIntosh'. Almost all apple cultivars had some blighted growth. Affected trees and cultivars generally had late bloom, especially on 1-year wood. Control was accomplished by breaking out affected shoot growth and branches, removing affected fruit, and applying a series of streptomycin sprays. Insecticides were included to control sucking insects. If a branch could not be taken out, it was removed by sawing well below the blighted portion. A change in weather from warm and humid to cool and dry, and hardening off of shoots aided in control. Since trees were being treated mainly as a low trellis hedgerow, spotting and getting to blighted areas was easily accomplished from the ground level, and obtaining good spray coverage of the trees was readily done. This was the second time in the life of the research orchard (18 years) that fire blight has become a problem. (L. D. Tukey, Penn. State Hortic. Reviews, July, 1986)

K. D. Hickey
Biglerville

ONTARIO

Fire blight was not a serious problem in Ontario in 1986, except in the Niagara peninsula where it became quite serious in pear orchards following hail.

Gordon Bonn
Harrow

BRITISH COLUMBIA

Fire blight was not as serious a problem in the Okanagan Valley of British Columbia in 1986 as it was in 1985. However pockets of fire blight did occur. For example, a serious outbreak occurred on an ochard near Okanagan Falls, British Columbia. The orchard which consisted of 'Bartlett' pears, several apple varieties and a relatively young planting of 'Newton' apples was heavily infected. The 'Newtown' apple trees were decimated by fire blight and will have to be removed. The infection followed an isolated summer hail storm.

Peter Sholberg
Summerland

ALBERTA

Nothing unusual in Alberta in 1986.

Ian Evans
Edmonton

MEXICO

Fire blight was quite severe on apples, mainly 'Golden Delicious', 'Jonathan' and some older varieties in Casas Grandes (Chihuahua). (from R. P. Covey, Wenatchee, Wash.)

During March and early April, there was a rather unusual rainy period when the apples and pears were blooming. In some areas, the pear bloom was severly damaged by fire blight, that is 90% or more, but not as much in the case of apples, even though there was some unqualified damage.

Leopold Fucikovsky
Chapingo

OTHER COUNTRIES

WEST GERMANY

In the northern part of Germany, fire blight was generally light because of cold temperatures in spring and too dry conditions in summer. Only hawthorn-hedges showed some infections. In Hessen, in central Germany, a

high incidence of the disease was observed in several apple orchards near Frankfurt; also the scion garden, which was affected last year, showed typical shoot infections on several apple varieties ('Gloster', 'Jonathan', 'James Grieve'). In the surrounding landscape, a high number of hawthorn-hedges were heavily infected (blossoms and shoots), moreover the susceptible ornamentals Cotoneaster salicifolius and C. watereri in housegardens and parks showed severe symptoms.

In the southern part of Germany, only in several places fire blight was found to a greater extent. In Baden-Wurttemberg, mainly in the area of Stuttgart, pear and quince trees and the high growing Cotoneaster types were predominantly attacked. For the first time several Crataegus shrubs showed infections. Moreover, the high growing pear trees for the "most" production were heavily attacked and many had to be cut down. In Rheinland-Pfalz, the disease now has been distributed over the whole area of this country especially on the susceptible ornamentals (Cotoneaster-species and Crataegus). Early in the season (May 23) blossom infections were found in several pear orchards on the varieties 'Red Clapps' and 'Conference'. In spite of immediate pruning measures two pear orchards had to be eradicated, whereas apple and quince-trees were not as severely attacked.

Wolfgang Zeller
Dossenhelm

ENGLAND

The incidence of fire blight was not high in the United Kingdom in 1986. In the South West, there was only one severe outbreak in perry pear, cv. 'Butt'. No data was obtained from a spray trial there because of the very low incidence of infection on cider apples.

Connie Garrett
East Malling

POLAND

In 1986, fire blight was recorded in new provinces, north from Skierniewice, on apples, pears and hawthorns. In general, the disease was not very active.

Peter Sobiczewski
Skierniewice

NETHERLANDS

Fire blight was generally not severe in 1986. However, in a few areas in the southern part of the country, weather conditions were favorable for the bacteria during pear blossoming period, causing a lot of blossom infections in pear orchards in South-Limburg and somewhat less in Zeeland.

During blossom period of hawthorn some infection was established in bushes and hedges, also mainly in the southern half of the country.
Because of the warm and dry summer, infections progressed slowly and could be eradicated easily, though some pear orchards were damaged badly by then. Shoot infections were not widespread and generally light in all host plants in the entire country, with an exception for South-Limburg again.

The stringent control measures (forced by law) taken in The Netherlands appear to be very effective. Infection pressure in the protected zones is more and more decreasing.

Rien van Teylingen
Wageningen

CYPRUS

During 1986, spread of fire blight continued and it is now found in almost all pear and apple growing areas of Cyprus. Although blooming occurred earlier than in the previous year, weather conditions were favorable for new infections and the development of the disease from the full bloom of pears and onward. Further spread of the infection in the trees was observed in autumn (October).

Intensive enlightening campaign was undertaken from the Department of Agriculture in order to attack the problem. Cleaning of the infected parts and spraying with copper compounds (Copac E, Kocide and Copper oxychloride) during bloom were recommended.

In general, the situation remained somewhat stable and the total production of apples and pears (for the country) was quite good.

Severe losses were mainly caused in Marathcissa and Solea areas, in orchards with severe 1985 infection. Most of the pear trees var. 'Superfine' and apple trees var. 'Pera Pedi' (=Pear Good Non-such) and 'Lord Lambourne' in these areas were completely destroyed. Infection was also observed on quince and wild crataegus.

A long term project for the uprooting and replacement of the severely infected trees of the susceptible pear and apple varieties was put in force in October, 1986.

Maria Dimova
Nicosia

EAST GERMANY

In 1986, we had again severe outbreaks of fire blight in the southern part of the GDR. Mainly hawthorn was infected.

Helmut Kleinhempel
Aschersleben

FRANCE

No further extension in France in 1986, with the noticeable exception of a single limited focus on 'Golden Delicious' in the Eastern part of the country (Haute-Savoie) (trees destroyed for samitation).

Poor disease activity in spring due to cool temperatures during pear blossom period. In late May and June severe infection on late flowering ornamentals (Cotoneaster, Pyracantha) in certain areas (Angers).

Jean Pierre Paulin
Angers

BELGIUM

For the first time we observed infection during primary blossom of pears. This was due to the late phenology and the absence of frost. The disease started this way in most of our orchards as well in pears as in apples.

Walter Porreye
St. Truiden

NORWAY

In August, 1986, an infection by Erwinia amylovora was discovered on different species of Cotoneaster in a district near Stavanger, on the South-West Coast of Norway. The weather conditions this year was probably very favourable to the disease in this area. It was a local outbreak, in private gardens, around public buildings and along roads, mainly on C. bullatus, but also on C. horizontalis, C. divericatus, C. salicifolius and C. lucidus.

Attack on apple, pear and hawthorn was not found.

The identity of the bacterium was confirmed by its growth characteristics on nutrient sucrose agar, the immature pear fruitlet test, pathogenicity on detached apple shoots, and immunofluorescense staining with specific antiserum from INRA, Angers, France.

In order to prevent further spread, an intensive information campaign and an official eradication program were carried out. A thorough survey of the district was made, tracing, removing and burning all attacked Cotoneasters. The tree stumps were killed by applying glyphosate.

To maintain the status of Norway as a non-infested country the survey will be continued next year. A special inspection program of nurseries and their surroundings will be carried out.

Arild Sletten
AS-NLH

SWEDEN

Fire blight has been discovered in one pear orchard in the southeast part of southern Sweden.

Approximately, 4-5% of the orchard was infected. All the diseased trees have now been eradicated. A supplementary survey was carried out in the surroundings without any new discoveries of the disease. Next year (-87) a new and even more intense survey is going to take place in the region.

Nearest known occurence of fire blight is on Bornholm, Denmark.

Maria Graberg
Jonkoping

IRELAND

In September, 1986, fire blight was found on Cotoneaster salicifolius on a nursery in Dublin. A nationwide survey subsequently revealed the presence of fire blight at several other sites in Dublin and at three isolated locations of Cotoneaster (45%), Crataegus (2%), Malus (2%), Pyracantha (40%), Pyrus (2%) and Sorbus 9%).

An eradication campaign was initiated and is continuing. All infected plants found have been destroyed.

An unusually severe storm with very strong north-easterly winds and exceptionally heavy rainfall occurred on 25/26 August and this was followed by a seven week long Indian summer.

To date, fire blight has been confirmed at 55 sites in Ireland - 52 in Dublin and one each in Co. Kildare (on Sorbus aucuparia), Clonmel, Co. Tipperary (on Sorbus aucuparia) and Wexford town (on Pyracantha). Genera found infected have been Cotoneaster (25 sites) Pyracantha (23 sites) Sorbus (4 sites) and Crataegus, Malus and Pyrus (1 site each).
We have found no new infections on apple or pear since those single findings in Dublin city last October.

Patrick Walsh
Dublin

GREECE

Fire blight has been found for the first time in Greece last year. It was recorded on the islands of Crete and Lesbos mainly on pear. The first infection was found on the cultivar 'Passa-crassana' in both areas. Later, trees of other cultivars as 'General Leclerk', Santa Maria', Abate Fetel' as well as local varieties, ('Kontoula' and 'Achtse') were found to be infected.

On the Island of Crete, infection on apple trees was also recorded but it was less severe than on pear trees. Only one case of infection on Crataegus sp. has been recorded. In this case the Crataegus plant was near an infected pear tree. The infection on Crataegus was very mild, only one or two. Young shoots were infected and the infection of the wild pear (Pyrus amygdaliformis) was rare. The weather conditions were unusual with many rain days at the end of April and the beginning of May.

An eradication campaign was immediately adopted and all the infected trees were uprooted and destroyed by fire; up to now more than 10,000 trees have been destroyed.

Peter Psallidas
Athens

NEW ZEALAND

Occassional isolated outbreaks. Weather conditions were dry during flowering and not conducive to fire blight.

Detailed inspections of apple orchards produced very little evidence of the disease.

Chris Hale
Auckland

SWITZERLAND

So far, no fire blight has been detected in Switzerland. Important measures have been taken against the disease.

The French Plant Protection Service reported to me that a significant outbreak of fire blight was observed on July 15 about 40 km south of Geneva. Following several weeks of warm humid weather in the second half of June, probably were instrumental to start the disease. Symptoms were observed on 130 'Golden Delicious' apple trees in an area of 8 ha.

Richard Grimm
Wadenswil

PORTUGAL

As far as I know, fire blight does not occur in Portugal.

J.M.S. Martins
Oeiras

HUNGARY

There is no fire blight in Hungary.

Erzsebet Simon
Hodmezovasarhely

ITALY

Surveys were made in nurseries and orchards located in different fruit growing areas. No cases of fire blight were detected and/or reported. Attacks of Pseudomonas syringae on pear trees in the Po valley must be reported. The official phytosanitary inspections of imported material for Erwinia amylovora were also negative.

Carlo Bazzi
Bologna

AUSTRIA

So far, fire blight was not detected in Austria.

Marianne Keck
Vienna

SPAIN

Fire blight has not been recorded in Spain. The usual surveys have been carried out.

Christina Noval
Madrid

SOUTH AFRICA

Fire blight not yet found in South Africa.

M. J. Hattingh
Stellenbosch

AUSTRALIA

Fire blight has not been detected in Australia and Plant Quarantine procedures for the import of fire blight hosts are aimed at preventing its introduction.

David Cartwright
Adelaide

DETAILS ON CURRENT FIRE BLIGHT RESEARCH REPORTED FROM SOME UNIVERSITIES AND EXPERIMENT STATIONS

ENGLAND

At Thames Polytechnic, Bob Rastall, with Dr. Tony Smith, is investigating the structure of EPS by mass spectroscopy and methylation analysis and study of phage EPS depolymerases. They are also making a characterization of outer membranes of E. amylovora and studying its interaction with host cells.

M. Wilson (University of Manchester) is obtaining interesting results from his study of population development of E. amylovora in Crataegus blossoms.

C.M.E. Garrett
Inst. of Hortic. Research
East Malling

Billing's fire blight risk assessment methods

I am increasingly worried about misconceptions and erroneous statements that are published.

Billing's system (1980a, b; 1984) combines local knowledge and experience of field risks (Billing, 1980a), which are not at present scored, with assessments of dissemination risks (rain and insects), establishment of infection risks and disease development rates (D-period analysis).

It can be used in all climates and for all purposes including: overall risk assessment (before, during and after bloom), timing of spray applications, timing of searches, comparison of relative risks in different seasons and different climatic areas, study of past outbreaks. Beware of sentences that start "Billing's system does not ..... It goes further than all other systems except in scoring field risks.

Where only part of the complete system is used, it should be referred to individually by name and not called Billing's system, eg.

Insect risk assessment (Billing, 1980b). Now modified.

Infection risk assessment (Billing, 1980b).

D-period (previously I-period) analysis (Billing 1980a). Small changes have now been made in the table of potential daily doublings (PD) and to the definition of a potential infection (PIF) day.

A full description of Billing's system, including modification made since 1980, is now in draft form. The validity of the system is being assessed against fire blight outbreaks.

Please consult me before publication if you have any difficulty with any part of the risk assessment system. If you make modifications (deliberate or accidental), please don't call it Billing's system.

Eve Billing
Horsmonden

NETHERLANDS

Breeding research on woody ornamentals. Res. Sta. for NS & UG.

A.S. Bouma

Cotoneaster

In greenhouse tests, 67 clones of seedlings of a number of Cotoneaster species were tested for fire blight resistance. The original seedlings were not attacked in a former test. Only 12 clones proved to be less susceptible. In an experimental field, clones of the following species were heavily attacked: C. sihangensis, C. dielsianus, and C. racemiflorus.

Some more or less field resistent species seem to be C. neuryensis , C. divaricatus, C. distichus, C. microphyllus, and C. praecox.

Crataegus

Seven hundred seedlings were tested in the greenhouse. Crataegus dalurica, C. crus-galli, C. douglasii and C. alemannensis again proved to be very susceptible. Of seeds from botanic gardens from all over the world, some 2700 seedlings were raised and will be tested next year.

Pyracantha

In the experimental field, the following varieties showed internal brown discoloration: 'Dart's daffodil', 'Orange Charmer' 'Sunshine', 'Golden Charmer', 'Soleil d'Or', and 'Laui'. Seedlings from crosses also showed these symptoms. Parents of these seedlings were: 'Teton', 'Dart's Daffodil' and 'Alexandria'.

About 900 Pyracantha seedlings four crosses were tested in the greenhouse. 'Dart's Red' and'Shawnee' seemed to be donors of genes of resistance.

Also, P. coccinea showed moderate susceptibility.

H.J. Schouten (Agricultural University, Wageningen) is developing a warning system against fire blight. In order to get a better understanding of the role of rain and humidity in the epidemiology of the disease, he is investigating the relationship between water potential of shoots, blossoms and nectar and the growth rate of Erwinia amylovora in each of these sites. He has initiated a study on the epidemiological effect of pruning and eradication of hawthorns in the neighborhood of pear and apple orchards.

M. Van Teylingen
Plant Protect. Serv.

POLAND

The potential for fire blight activity (PFA), assessed according to the Billing system, for the years 1983 to 1985 in the region where fire blight was first discovered in Poland in 1966, and for the years 1984 and 1985 in the new area in the center of the country, showed, generally, the correspondence to the disease occurrence in nature, especially in the first part of the vegetation period. The discrepancies which occurred indicate the necessity of taking into consideration other factors. It seems especially important in regions where fire blight occurs endemically. For comparison, the system proposed by Beer and co-workers will be tested.

The protective activity against fire blight of 7 chemical samples synthesized at the Warsaw Institute of Organical Industry and the new Polish garlic preparation Albarep were evaluated on pear fruitlets cv. 'Conference'. None of the tested compounds gave satisfactory effect and all were less effective than copper compounds /Kocide 101, Miedzian 50/ or Agrimycin.

P. Sobiczewski
Res. Inst. of Pomology

ONTARIO

Current fire blight projects at Harrow Research Station are:

1) Selection of pear breeding material for fire blight resistance.
2) Reaction of pear cultivars to Erwinia amylovora strains.
3) Selection of apple and crabapple cultivars for resistance.
4) Fire blight prediction.
5) Evaluation of bactericides for control of fire blight.

W.G. Bonn
Agriculture Canada

BELGIUM

Severe ooze formation on branches of 'Conference' trees without any symptoms on the leaves. This fact has given problems for the control of the disease in the orchard. We observed a serious extension of the disease on the trees around such trees without symptoms. In this case we suppose they were infected late in the previous season.

T. Deckers
Res. Sta. of Gorsem

CYPRUS

Results of preliminary screening of chemicals for fire blight control are shown below:

On pear trees var. 'Superfine' - Laniti - during bloom, (1986).

	Treatment	Dosage	Total No. of strikes on four trees	Mean No. strikes per tree	% protection
1.	S 0208	150gr/100 l	41	10.25	97
2.	Copac E	75cc/100 l	266	66.5	78
3.	Control	-	1209	302.0	0

On pear trees var. 'Superfine' - Trikoukia (1986)

	Treatment	Dosage	Total No. of strikes on four trees	Mean No. strikes per tree	% protection
1.	Kocide	30gr/100 l	314	78.5	14
2.	Kupravit	120gr/100 l	91	22.7	75
3.	Control	-	366	91.5	0

On apple trees var. 'Pera Pedi' during bloom, (1986)

	Treatment	Dosage	Total No. of strikes on four trees	Mean No. strikes per tree	% protection
1.	Cupravit	120gr/100 l	753	188.0	61
2.	Kocide	30gr/100 l	1903	476.0	2
3.	S 0208	150gr/100 l	229	57.0	88
4.	Copac E	75cc/100 l	1592	398.0	18
5.	Control	-	1938	485.0	0

M. Dimova
Dept. of Agriculture

WEST VIRGINIA

A few new materials were available for testing for fire blight control in 1986. Weather conditions were not condusive to a good fire blight test even though the trees were spray-inoculated. We can conjecture, but the tests will be repeated in 1987.

J.G. Barrat
WVU Expt. Farm

GREECE

1) A detailed study of climatic data and assessment of fire blight epidemics in same places in Greece has been undertaken in the framework of E.E.C. (Agrimed) program in colaboration with the French Meteorological office.

2) After the occurence of the disease, a study of the characteristics of Erwinia amylovora isolates from different hosts and localities is underway at the Laboratory of Bacteriology.

P. Psallidas
Benaki Phytopath Inst.

SWITZERLAND

Following the progress of the disease in Western Europe and as a consequence, many nurseries, orchards, public and private parks have been examined intensively for symptoms of fire blight. Suspected plant material has to be sent to the bacteriology services for detection of Erwinia amylovora. One service has been developed in Wadenswil, another was recently started in Changins.

As a prediction service for Swiss fruit growers, data from ten automatic weather stations are sent daily to Wadenswil where they are processed by computer for the warning system developed by Billing. These ten weather stations are set up throughout the country, because the climate in Switzerland is very variable.

Furthermore, an estimate of fire blight risk, developed by Steve Beer is being made in many important orchards. Results of the combination of the weather and orchard factors concerning fire blight will be available for the local plant protection services and other offices, interested in this problem.

Since 1979, specific Swiss apple and pear varieties are included in a susceptibility test of many varieties in the USA (T. van der Zwet). Based on these results, nurserymen can be advised which varieties of apples, pears and ornamental plants should be propagated more and which should be eliminated. A similar program will be started in the Federal

Republic of Germany (W. Zeller), in Canada (W.G. Bonn and F. Kappel) and in France (B. Thibault). It is hoped that in these and other programs some resistance against fire blight (or other diseases) will be found and that the expected genetic material can be used for further breeding work.

R. Grimm
Fed. Res. Station

EAST GERMANY

Current research projects at the Institute of Phytopathology in Aschersleben are:

- Further investigations on methods of warning and forecasting.
- Evaluation of pear, apple and ornamental varieties for resistance to fire blight
- Continuation of control trials on pear, apple and ornamentals.

H. Kleinhempel
Inst. for Phytopath.

PORTUGAL

A research project, (1) to make a survey on cultivated and spontaneous plants every spring and early summer, (2) to implement and utilize in Portugal Billing's predictive system, and (3) to prepare actions of extension and public information, was submitted to the National Institute and Agricultural Research Station of Portugal in February, 1986, by J.M.S. Martins and C. Jacob.

It was not yet financed.

J.M.S. Martins
Estac. Agronom. Nac.

ITALY

The breeding program for pear resistance to fire blight continues; this program was undertaken by the Istituto Sperimentale per la Frutticoltura in Rome, in 1980, under the EEC fire blight working group. Up to now, 8400 pear seedlings have been obtained.

In accordance with the ministerial Decrees of 23/XII/1983 and 27/II/1986, which regulate the Italian imports of E. amylovora host plants, the Bologna Plant Protection Service had continued to carry out the bacteriological analysis of samples of dormant plant material on its arrival in Italy as well as the inspections during the two-year "quarantine period" in specified areas before being released on the market.

C. Bazzi
Istit. Patol. Veget.

WEST GERMANY

In the attacked area of Hessen (50 km south of Frankfurt) a monitoring together with the forecasting system of BILLING was carried out in 1986 in 3 apple orchards and in an infested scion garden. Epiphytic stages of E. amylovora could be found on apple leaves ('Gloster', 'Boskoop', 'White Transparent') nearly during the entire season. Dependent on the weather conditions, changes in the bacterial population were observed. A marked increase was found after rainfall and temperatures above 19°C, whereas dryness and low temperatures induced a strong decrease. Further research on the microflora of the phyllosphere of apple, pears and ornamentals will be continued in the next year.

A cooperation in testing swiss pome fruit varieties under German conditions is planned with H. Grimm, Wadenswil.

Other projects:
1. Control experiments with new bactericides.
2. Resistance studies on a new testplot in the South of Germany (near Heidelberg) with native and foreign pome fruit varieties.
3. Physiological studies on the EPS of E. amylovora.

W. Zeller
Inst. for Pflanzensch.

SPAIN

Current research project at the I.N.I.A. is: The main preventive and control measures of the fire blight pathogen under Spanish climatic conditions.

C. Noval
Inst. Nac. Ivest. Agrar.

NEW THESES AND DISSERTATIONS

Schilli, Ernst:
Untersuchungen zur Epidemiologie, Prognose and Bekampfung des Feuerbrandes an Kernobst, verursacht durch Erwinia amylovora (Burr.) Winslow et al.
Ph.D.Diss., Univ. Stuttgart-Hohenheim, 1986, 135 pp.

Shoeib, Alioa A.:
Studies on the Fire Blight Disease of Pears in Egypt.
Ph.D.Diss., Alexandria Univ., 1986, 86 pp.

Joest, Marion:
Untersuchungen zur Populationsdynamik des Feuerbrandes (Erwinia amylovora Burill Winsl,et al.) in Sudhessen im Hinblick auf eine Prognose der Krankheit.
Diplomarbeit T H Darmstadt, 1987, 94 pp.

MISCELLANEOUS NEWS

Chris Hale visited Sherm Thomson (Utah State University), Bob Goodman (University of Missouri) and Tom van der Zwet (USDA-AFRS) following the 4th International Workshop on Fire Blight in New York.

Dr. Alia A. Shoeib finalized her Ph.D. thesis in the Laboratory of Dr. Zeller, Dossenheim and after a stay of 2 1/2 years returned to Alexandria University (30 June, 1986)

May 5-7, 1986, EPPO meeting at Angers on Bacterial Plant Diseases included a session on Fire Blight at which Paulin (France), Van Vaerenbergh (Belgium), Stead (U.K.), and Zutra (Israel) spoke on epidemiology and control and Laroche and Verhoyen (Belgium) spoke on serological diagnosis.

Fire blight was featured in an SEB meeting on Bacterial Plant Pathology in Manchester, January 6-8, 1987 with contributions from E. Billing, R. Rastall, D. Youle and M. Wilson.

E. Billing and C.M.E. Garrett were the U.K. delegates to an EEC Fire Blight Workshop meeting in Brussels, February 3, 1987 at which plans for continued cooperation in fire blight research among the member countries of the community were discussed.

H. Aldwinckle from Geneva, N.Y., is on sabbatical for 5 months at INRA-Angers, France (with Paulin and Lespinasse) to study strain virulence and vitromethods.

J. Vanneste, presently post-doc in Ithaca, N.Y. (S.V.Beer) will be back in Angers in September, 1987.

EEC-AGRIMED group on fire blight (chairman: J.P. Paulin) has held its meeting in Brussells on 2 Feb., 1987. Due to the increasing activity of the disease in the Mediterranean area (Egypt, Israel, Cyprus, Crete), it is likely that the group will ask for a renewal of the contract after December, 1988. There were 26 fire blight enthusiasts in attendance.

Dr. Gordon Bonn (Harrow), visited the Appalachian Fruit Research Station at Kearneysville, West Virginia, following the third workshop on fire blight in New York.

After years of planning and more than two years of construction, the new building on Agriculture Canada's Summerland Research Station grounds is now completed, occupied and fully operational. This elegantly landscaped multiple-use office and laboratory facility is situated on a promontory overlooking Okanagan Lake approximately 10 km north of Penticton, B.C. It houses 25 scientists and 65 support staff of Agriculture Canada's newest research station.

FUTURE MEETINGS

August 2-6

Annual meeting of American Phytopathological Society
Cincinnati, Ohio.

August 31-September 4

3rd Intern. Working Group on *Pseudomonas syringae* pathogens.
Oeiras, Portugal.

September 17-20

Fallen Leaf Lake Conference on *Erwinia*
South Lake Tahoe, California

August 20-27, 1988

5th Intern. Congress of Plant Pathology
Kyoto, Japan

November 11-17, 1988

Annual meeting of American Phytopathological Society
San Diego, California

June 11-16, 1989

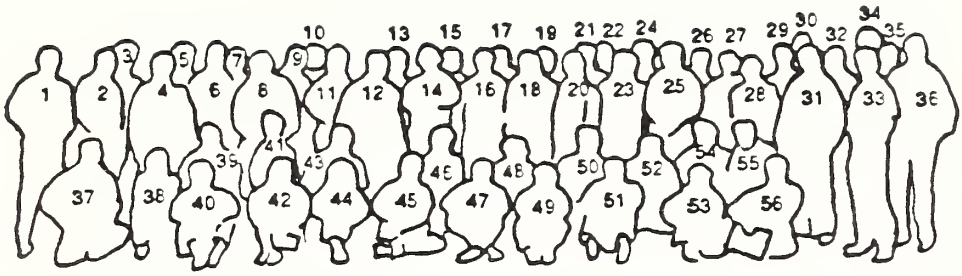
7th Intern. Conference on Plant Pathogenic Bacteria
Budapest, Hungary

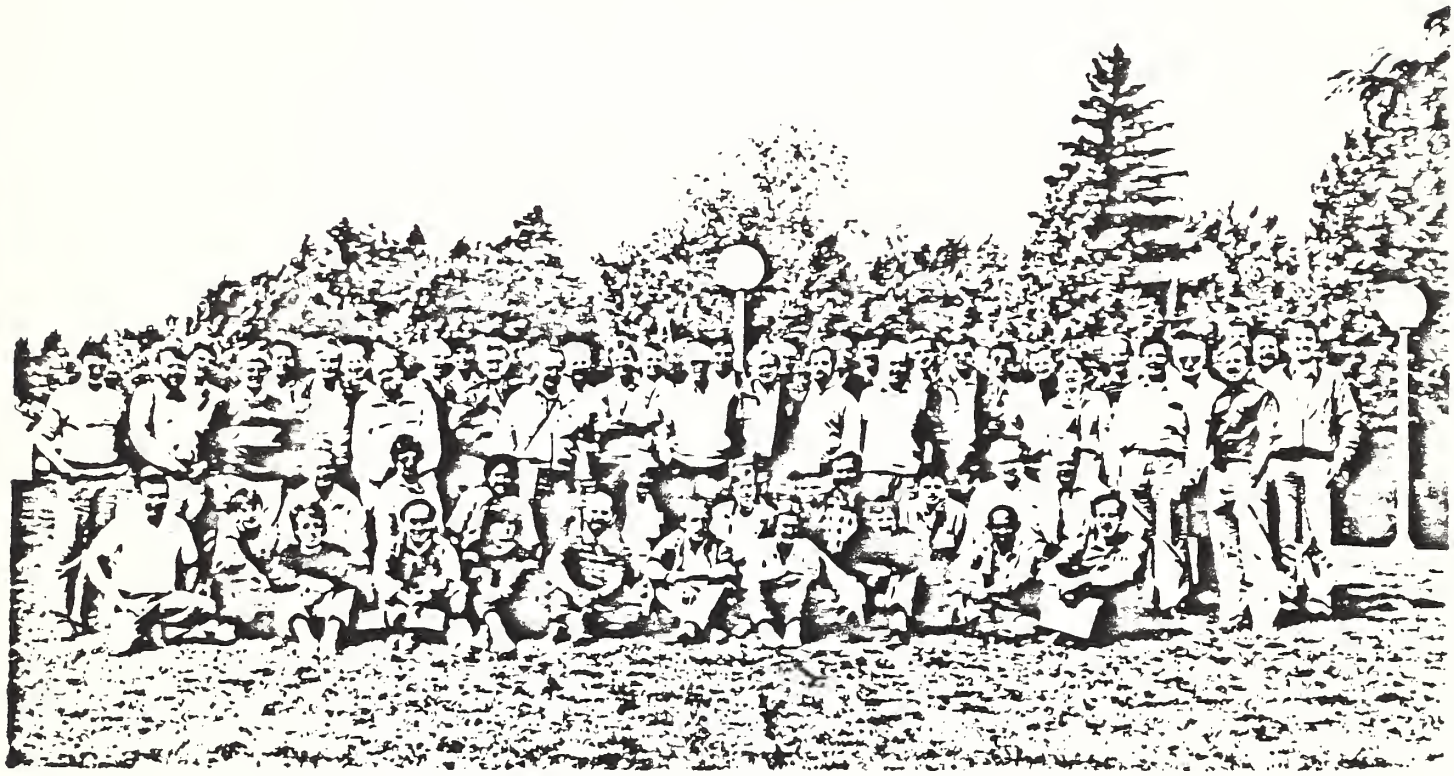
June (3rd week), 1989

5th Intern. Working Group on Fire Blight Research

Limburgs Universitair Centrum

Diepenbeek (near Hasselt), Belgium





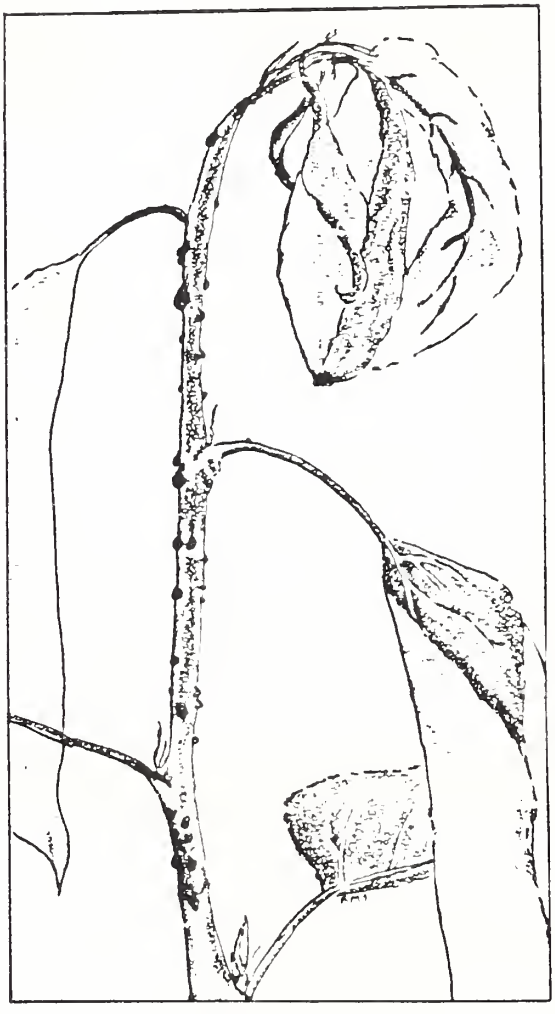
Fourth International Workshop on Fire Blight
Cornell University, Ithaca and Geneva, New York - June 22-26, 1986

1. M. Wilson, United Kingdom
2. D. Mappes, Federal Republic of Germany
3. A. Cadic, France
4. K. Hickey, Pennsylvania
5. D. Sugar, Oregon
6. C. Bazzi, Italy
7. R. Byrde, United Kingdom
8. D. Zutra, Israel
9. A. Jones, Michigan
10. A. Mendoza, Mexico
11. D. Myers, Florida
12. P. Sobiczewski, Poland
13. B. Thibault, France
14. R. Cooper, United Kingdom
15. T. Deckers, Belgium
16. R. Goodman, Missouri
17. J. Geenen, Belgium
18. J.-P. Paulin, France
19. J. Roberson, Georgia
20. G. Bonn, Canada
21. A. Dia, Egypt
22. C. Manceau, France
23. M. Hattingh, South Africa
24. J. Vanneste, France
25. S. Thomson, Oregon
26. J. Laurent, France
27. H. Kleinhempel, German Democratic Republic
28. C. Jacquart-Romon, France
29. C. Hale, New Zealand
30. M. Laroche, Belgium
31. S. Beer, New York
32. R. Lamb, New York
33. H. Aldwinckle, New York
34. D. Youle, United Kingdom
35. H. Epton, United Kingdom
36. D. Sigee, United Kingdom
37. J. Norelli, New York
38. R. Ben-Arie, Israel
39. Z. Ben-Arie, Israel
40. A. Sletten, Norway
41. R. Ben-Arie, Israel
42. C.-P. Lin, New Jersey
43. W. Wilcox, New York
44. R. Quarta, Italy
45. B. Delp, New Jersey
46. C. Garrett, United Kingdom
47. C. Becker, New York
48. S. Bouma, The Netherlands
49. T. Umholtz, New York
50. R. Grimm, Switzerland
51. R. Bell, West Virginia
52. J. Viseur, Belgium
53. S. Wimalajeewa, Australia
54. R. Wodzinski, New York
55. T. van der Zwet, West Virginia
56. T. Smith, Washington

Fourth International Workshop on

Fire Blight

ABSTRACTS



June 22-26, 1986

Ithaca, New York
USA

International Society for Horticultural Science

Deciduous Tree Fruit Disease Workers

Cornell University

NO FIRE BLIGHT IN SWITZERLAND YET, BUT MEASURES HAVE BEEN TAKEN AGAINST THE DISEASE. Richard Grimm, Swiss Federal Research Station, CH-8820 Wädenswil, Switzerland.

Since the last fire blight workshop in Bordeaux in 1983, the fire blight situation has not changed much in Central Europe. So far, no fire blight has occurred in Switzerland, but the disease is present near the Swiss border in France and Germany. Orchards in border areas have been examined intensively for symptoms of fire blight. A bacteriology service for detection of Erwinia amylovora was initiated in the French-speaking part of Switzerland in collaboration with the Research Station at Wädenswil. As a prediction service for Swiss fruit growers, the data from ten automatic weather stations are sent daily to Wädenswil where they are processed by computer for the warning system developed by Billing. Furthermore, an estimate of fire blight risk (Beer) is being made in many orchards . Presently, Swiss law on apple imports is changing. The new law will allow imports from regions with fire blight under certain conditions (e.g. fruit imports only in new boxes with a phytosanitary certificate).

FIRE BLIGHT - A NEW DISEASE IN ISRAEL. Ezra Shabi and Dan Zutra. Department of Plant Pathology, Agricultural Research Organization, The Volcani Center, P.O. Box 6, Bet Dagan, Israel.

In Israel, fire blight had not been found previously, in spite of extensive cultivation of host plants. In May 1985, symptoms characteristic of fire blight were observed and from May to August Erwinia amylovora was isolated from eight pear orchards and two apple orchads. In three of the pear orchards, 5-10 percent of the trees showed symptoms, whereas in the five others only a few trees were affected. Of the more severely infected pear orchards, two were about 25 years old and one was six years old. The affected pear orchards are located in two regions 200 km apart. Five are scattered over a distance of about 100 km in the Galilee in the north, and three adjacent orchards are in the southern coastal plain. On apple, the disease was found in a few trees in two adjacent orchards in the Galilee. In April 1986, the disease was detected at eight new sites scattered all over Israel, including one pear orchard in the Negev Desert in the south. Based on analysis of the 1977-1985 temperature and rainfall records from five meteorological stations located close to the infected orchards, it can be assumed that fire blight could become endemic in Israel.

OCCURRENCE OF ERWINIA AMYLOVORA ON APPLE FRUIT IN NEW ZEALAND. C. N. Hale*, E. M. McRae*, and S. V. Thomson**. Plant Diseases Division*, DSIR, Auckland, New Zealand. Utah State University**, Utah, USA.

Apple orchards with different levels of fire blight infection were surveyed through the 1984-85 growing season for the presence of Erwinia amylovora on the surface of shoots, flowers and fruit at different stages in development up to full maturity. E. amylovora was not detected in washings from samples from orchards in which no fire blight symptoms were seen. The pathogen was occasionally detected in washings from shoots and immature fruit from orchards with 1-2 infections/tree. In an orchard with 75 infections/tree E. amylovora was detected regularly from shoots, flowers, immature and mature fruit. However, in this orchard the frequency of detection of the pathogen in washings from maturing fruit declined from 50% of fruit samples for fruitlets to 3% for mature fruit.

Commercially packed apple fruit from orchards with different levels of fire blight infection were also surveyed for the presence of E. amylovora. The pathogen was not detected in washings from fruit from the orchards in which no fire blight symptoms were seen nor from fruit from the orchards with 1-2 infections/tree. However, E. amylovora was isolated from a small number (<1%) of fruit from the orchard severely affected by the disease. For both fully mature and packed fruit E. amylovora was detected in washings only from the calyx end and not from the fruit epidermis. This suggests that the pathogen is more likely to survive in association with the dried remnants of the flower parts.

From the results of these surveys we conclude that apple fruit harvested from orchards in which no fire blight symptoms are seen during the growing season are unlikely to constitute a means of disseminating fire blight.

BUD BLAST, CANKER AND DIEBACK OF APPLE IN MASSACHUSETTS. Roberts Spitko and Daniel Cooley, New England Fruit Consultants, P.O. Box J, Lake Pleasant, MA 01347, and Dept. of Plant Pathology, University of Massachusetts, Amherst, MA 01003.

For the past 8 years, a bud blast and branch dieback was observed in several orchards in central Massachusetts. Symptoms were noted in young trees in the 3rd to 10th year of growth. Trees affected were primarily Marshall McIntosh, an early coloring strain being planted widely in the northeastern United States. First evidence of the condition was retention of the previous season's leaf petioles on vegetative shoots. Vegetative and flower buds blasted at various stages of early development. Other shoots apparently grew out of the condition normally. No other symptoms were observed until the 3rd week of June when a rapid decline phase was noted. Tissues wilted and died rapidly; often cankers formed at the base of affected shoots. Cankers occasionally advanced to kill scaffold limbs or entire trees. In 1984, a widespread bud blast and dieback problem occurred on McIntosh and several other cultivars. Symptomology appeared identical to that observed in central Massachusetts since 1978. No single organism was consistently associated with affected tissues although Pseudomonas, Erwinia and numerous wood-rotting fungi were found. Isolations made in 1985 in orchards where the condition was originally observed indicated Erwinia amylovora was the primary pathogen. It is unknown what caused the widespread dieback problem in 1984.

EFFECTS OF MEDIUM AND PHYSIOLOGICAL AGE ON FATTY ACID PROFILES OF ERWINIA AMYLOVORA. Francesca J. Casano, John M. Wells and Thomas Van der Zwet. Istituto Sperimentale per la Patologia Vegetale, Rome, Italy, USDA, ARS, Rutgers University, New Brunswick, N.J., USA and USDA, ARS, Kearneysville, W. Va., USA.

Profiles of cellular fatty acids were developed for 3 strains of Erwinia amylovora grown on NA, TSA, KB and GYCA media for 1, 3 and 6 days at 27°C. Total fatty acids consisted of 43% saturated even-carbon straight chains, 6% saturated odd-carbon chains, 34% unsaturated acids, 6% hydroxy-substituted acids, 1% branched chains, 4% cyclic acids, and 6% unidentified components. Composition was affected by growth medium and physiological age of cells. On TSA and NA medium saturated odd-carbons and cyclic acids averaged 7-10% and 4-5%, respectively. On KB and GYCA they averaged 1-2% and 2-3%, respectively. Between day 1 and day 6 of growth saturated fatty acids increased from 46 to 50%, and unsaturated acids decreased from 48 to 30%. Cyclic acids were significantly higher in 3 and 6-day old cells than in 1-day old cells.

IDENTIFICATION OF ERWINIA AMYLOVORA THROUGH THEIR METABOLITIES, USING INDIRECT ELISA. Marc Laroche, Claudine Givron and Michel Verhoyen. Centre d'Etudes des Phytobactérioses, Laboratoire de Phytopathologie, Université Catholique de Louvain, Louvain-la-Neuve, Belgique.

Use has been made as antigen in ELISA of the supernatant obtained after centrifugation of liquid culture media inoculated with *E. amylovora*. The corrected optical density (cOD) observed after 4.30 hours of enzymatic reaction reached a mean value of 1.110 for the 91 strains examined. In contrast, the cOD obtained for 90 strains of other bacterial species were generally lower than 0.130.

It has also been shown that the association of *E. herbicola*, or *P. fluorescens* or *P. syringae* with *E. amylovora* in a same culture medium did not disturb the detection of this latter. The cOD values observed for mixed bacterial cultures were at least 2.5 times higher than those obtained for unmixed cultures.

The use in ELISA of metabolites produced by *E. amylovora* allows thus a good and specific identification of this bacterium.

FIRE BLIGHT RESEARCH IN THE NETHERLANDS

Anna Sophie Bouma
Institute for Horticultural Plantbreeding (IVT)
Wageningen, the Netherlands

The research on fire blight in the Netherlands is done at different research institutes, vz. the Plant protection Service (PD), the Institute for Plant protection (IPO), the Institute for Horticultural Plantbreeding (IVT), the Research Station for Fruit Growing, the Dorschkamp Research Institute for Forestry and Landscape Planning, Research Station for Nursery Stock and Urban Greenery (PBSG) and the Agricultural University.
The research workers are joined in the Dutch Working Group on Fire blight Research (WOB). They are working with Cotoneaster, Crataegus, Pyracantha and Pyrus. Topics of the research are: epidemiology, variety testing, breeding for resistance and chemical control. Each of these topics will be explained.

POST - ENTRY QUARANTINE SCREENING PROCEDURES TO PREVENT ENTRY OF FIRE BLIGHT INTO AUSTRALIA.

Satish Wimalajeewa, Plant Research Institute,
Department of Agriculture, Burnley, Victoria, Australia.

Australia has hitherto remained free of fire blight largely due to very stringent plant quarantine regulations, applied especially to imports of rosaceous propagating material. Currently all fire blight hosts imported are kept under quarantine observation for three years before release. This excessively long period is now feared to result in substantial smuggling in of apple and pear propagating material, thus considerably increasing the risk of introducing fire blight. It is principally to surmount this problem that the following new screening procedure, which could be completed in one season, has been proposed. All propagating wood will be imported only from approved sources, and should have originated from properties which were free of fire blight during the current and previous season. On arrival they will be examined for fire blight, and if free, will be disinfected and either budded or grafted. New growth will be inspected for disease, and the proximal portion of it removed and further checked on a modified nutrient sucrose agar medium for Erwinia amylovora, any resulting bacterial growth will be tested serologically. If it is found free of E. amylovora, the distal portion of new growth will be released to the importer.

PRELIMINARY DISCRIMINATION OF ERWINIA AMYLOVORA STRAINS BY FATTY ACID PROFILING

Constance M.E. Garrett, Patrick S. Blake,
Diana A. Fletcher, Douglas J. Austin
East Malling Research Station, Maidstone, Kent ME19 6BJ, UK

Selected virulent and avirulent isolates of Erwinia amylovora are being characterised by GC/MS-profiling of their whole cell fatty acid components (Sasser and Miller, 1985). The approach shows promise of good correlations between these profiles and the biological attributes of these organisms.

PRODUCTION OF RAT MONOCLONAL ANTIBODIES SPECIFIC TO ERWINIA AMYLOVORA. Josee Hutschemackers*, Michel Verhoyen*, and Hervé Bazin**. Laboratory of Plant Virology*, University of Louvain, Place Croix du Sud, 3, B-1348 Louvain-la-Neuve, Belgium. Experimental Immunology Unit**, University of Louvain, Clos Chapelle-aux-Champs, 30, B-1200 Brussels, Belgium.

Hybridoma cell lines secreting monoclonal antibodies to *Erwinia amylovora* were produced by fusing splenocytes or popliteal ganglionary cells from immunized LOU/C rat with myeloma cells of the nonsecreting IR983F fusion line.
Three hybridoma cell lines (LO-Ea-10, LO-Ea-15 and LO-Ea-18) were selected because they produced monoclonal antibodies specific to *E. amylovora*. The monoclonal antibodies (LO-Ea-10, LO-Ea-15 and LO-Ea-18) purified from ascitic fluid reacted in indirect immunofluorescence and in indirect enzyme-linked immunoassay with 93 strains of *E. amylovora* from 7 different geographic areas. Those monoclonal antibodies did not react with strains of *E. mallotivora*, *E. quercina*, *E. herbicola*, *E. milletiae*, *E. carotovora*, *E. chrysanthemi* and *E. uredovora*. Moreover they did not react with pseudomonas, xanthomonads and enterobacteria species.
The monoclonal antibody LO-Ea-18 reacted by indirect enzyme-linked immunoassay with the supernatants of liquid cultures inoculated with 90 strains of *E. amylovora* but did not react with the supernatants of liquid cultures inoculated with 88 strains of other bacterial erwinia, corynebacteria, pseudomonads, xanthomonads, agrobacteria and enterobacteria species.
The monoclonal antibody LO-Ea-18 can be used for the detection of fireblight.

IN VITRO AND IN SITU DETECTION OF ERWINIA AMYLOVORA WITH MONOCLONAL ANTIBODIES. C. P. Lin, T. A. Chen, J. M. Wells, Plant Pathology Department and USDA, ARS, Rutgers University, New Brunswick, NJ 08903, and T. van der Zwet, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430.

Monoclonal antibodies (MA) specific to Erwinia amylovora were used to identify and detect the epiphytic and endophytic E. amylovora in bacterial cultures and pome fruit tissues by indirect ELISA and immunofluorescent staining. Ten clones of species specific MA did not cross-react to any epiphyte or identified bacterial strain in the ELISA. The antibodies were thus used in the in vitro identification and detection of E. amylovora in different bacterial cultures by indirect immunofluorescent staining. Except clone 37A12, the other clones reacted with the surface antigens of E. amylovora to yield strong fluorescence and were further used in the in situ detection. Positive fluorescence was observed under epifluorescent microscope in infected apple tissues but not in healthy controls.

DIRECT COUNTS OF ERWINIA AMYLOVORA BY IMMUNOFLUORESCENT STAINING WITH MONOCLONAL ANTIBODIES. C. P. Lin, T. A. Chen, J. M. Wells, Plant Pathology Department and USDA, ARS, Rutgers University, New Brunswick, NJ 08903, and T. van der Zwet, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430.

Modified direct-count technique was applied in the identification and detection of E. amylovora by immunofluorescent staining with monoclonal antibodies (MA). Bacterial suspension prepared from pure cultures or rinsed from the infected pome fruit blossoms were pelleted in a microcentrifuge tube at 13,000 g for five min. Bacterial pellets were resuspended and incubated in MA for one hour, then centrifuged and resuspended in Fluorescein isothiocyanate (FITC) conjugated antimouse immunoglobulin for another one hour. Bacteria were then collected on polycarbonate membranes by filtration and examined under epifluorescent microscope. This technique can conveniently detect 5×10^3 cells and is useful in detecting and monitoring the infection of E. amylovora in pome fruit trees and fruits.

UTILIZATION OF I.R. PHOTOGRAPHY AND VIDEO TECHNIQUE TO DETECT INTERNAL LESIONS OF FIRE BLIGHT. G. Lachaud*, B. Foncelle**, J. Riom**, D. Guyon**, and J. P. Paulin*. INRA, Pathologie Végétale*, Angers, 4900, France. INRA, Télédétection**, Bordeaux, 33140, France.

The control of the inoculum level in an orchard before bloom rely mainly on the destruction for sanitation of lesions resulting from previous year's infections. Such lesions, on trunks and limbs may be very difficult to detect, especially if they originate from late infections (September-October).

We have checked that a technique previously described by SPECHT and BEER (1975) gives satisfactory results to visualize otherwise undetectable lesions, provided suitable filters and films are used. Histological studies of tissues of the surface of lesions and their surroundings show modifications in the shape of cells of the cortical parenchyma invaded by the bacteria. There is no clear-cut limit between healthy and diseased tissues, but a progressive evolution. The study of the optical properties of these tissues with a spectrophotometer (VARIAN CARY 17 DI) shows that the IR radiations are much more absorbed when histological modifications of cortical parenchyma are more important. The strongest difference is observed for radiations comprised between 700 and 900 nm which correspond to the sensitivity of IR films.

These facts explain the good quality of the contrast shown by pictures obtained with IR photography (KODAK HIGHT SPEED INFRARED FILM) associated with a filter (WRATTEN 87 C), or with a video-system (AKAI, tube VIDICON 2/3 inch.) equiped with the same filter. Obviously such a video system would be much more convenient for practical use in the orchard.

PAPERS IN PREPARATION
Eve Billing, Horsmonden Kent TN12 8LN, UK

It is my intention in the coming year to prepare reports of most of the unpublished fire blight experimental work done at East Malling Research Station (EMRS) between 1969 and 1982. Outline accounts can be found in EMRS Annual Reports. Topics covered include the following. Leaf and bud scar infection (1973,75,76,79); overwintering studies(1969,73,79,80); prebloom infections(1981,82); infection of undamaged shoots(1973); cryptic infections(1973,75,76); apple rootstock susceptibility(1974,76,77); epiphytic bacteria(1969,73,76,77). In addition I have further reports to make on studies on avirulent strains of Erwinia amylovora and on methods (in draft now), applications and evaluation of fire blight risk assessment systems and the history of fire blight in England.

A COMPARISON OF FIRE BLIGHT INCIDENCE AND ENVIRONMENT BETWEEN NEW ZEALAND AND WESTERN UNITED STATES. Sherman V. Thomson and Chris N. Hale, Department of Biology, Utah State University, Logan, and DSIR, Auckland, New Zealand

Fire blight was first reported in New Zealand in 1919 and spread rapidly into all pip-fruit growing areas. It was quite serious for a few years but then waned and has not been a major threat to the fruit industry since. Minor outbreaks occur in some of the fruit growing areas almost every year, but major outbreaks are infrequent despite the plantings of susceptible apple and pear varieties. The Prediction model of Thomson and a modified Billings model were used to estimate the years when fire blight would likely be serious. A high frequency of years appears to be conducive to fire blight in some growing areas of New Zealand and indicates that fire blight should be a frequent problem. However, the incidence of blight is much less than anticipated and suggests that factors other than environment may be restricting the development of fire blight. Populations of epiphytic, saprophytic bacteria in pear and apple flowers are generally greater in New Zealand than in western U.S. These saprophytic bacteria may be restricting the development of blight in New Zealand by providing some degree of biological control.

MULTIPLE REGRESSION ANALYSIS OF FACTORS ASSOCIATED WITH THE OCCURRENCE OF BLOSSOM INFECTION IN THE NORTHEASTERN UNITED STATES. S. J. Schwager*, S. V. Beer*, J. L. Norelli**, H. S. Aldwinckle**, and T. J. Burr**. Department of Biometrics, Departments of Plant Pathology, Cornell University, Ithaca*, NY 14853 and Geneva**, NY, 14456, USA.

The relative risk of the occurrence of severe fire blight in specified orchard blocks in a given season is analyzed by the method of logistic regression with multiple predictors. This technique allows the inclusion of both factors particular to individual orchard blocks, which affect host susceptibility and the availability of inoculum, and weather conditons, which affect the dissemination and multiplication of Erwinia amylovora. A regression model has been developed using data from orchard blocks in New York, Pennsylvania, Virginia, and West Virginia, collected during the 1983 and 1985 seasons. Specific orchard risk factors and weather risk factors associated with fire blight are discussed. The determination of overall risk of fire blight is considered. This approach could be used as a basis for recommending the application of bactericide sprays to prevent blossom infection.

POTENTIAL RISK OF FIRE BLIGHT OUTBREAKS IN ONTARIO USING BILLING'S SPRING SYSTEM

W. GORDON BONN, Agriculture Canada Research Station, Harrow, Ontario NOR 1GO

Billing's System I was used to assess fire blight risk in six diverse fruit-growing regions in the province of Ontario. Modifications to System I were applied in the spring to account for water availability and insect activity during the bloom period. Comparisons are made among the geographic regions and within the regions for different growing seasons.

WEATHER ANALYSIS WITH BILLING'S SYSTEM AND FIRE BLIGHT OCCURRENCE IN POLAND

Piotr Sobiczewski*, Stanislaw Berczynski*, Lidia Piotrowicz**

* Research Institute of Pomology and Floriculture, Skierniewice, Poland
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The potential for fire blight activity (PFA) was assessed according to the Billing system for the years 1983-1985 for the region where fire blight focus was first discovered in Poland in 1966 and for the years 1984-1985 for the new area in the center of the country. In the center the disease was first recognized in 1985 in several commercial apple orchards and on wildgrowing pear and hawthorns. In both regions, which are different according to climatic conditions and phenology, the meteorological stations were located about 5 km from the orchards under observation. The obtained results were compared with observations on the real disease occurrence. Generally, it was found that the calculated PFA corresponded to the fire blight occurrence in nature, especially in the first part of the vegeta tion period. The disagreements observed and the possibilities of the practical use of the system is discussed.

A COMPUTER PROGRAM BASED ON BILLING'S SYSTEM 1 FOR TIMING OF CONTROL MEASURES AGAINST FIRE BLIGHT. C. Jacquart-Romon*, J. P. Paulin**, and D. Payen,*. Météorologie Nationale-Agrométéorologie*, 2, Avenue Rapp, 75043, Paris, France. INRA, Station de Pathologie Végétale**, 49000 Angers, France.

BILLING's system 1 has not been devised to be used as a spray warning system. Nevertheless, it could provide suitable basis for such a system, as soon as reliable weather forecasts of suitable meteorological data are available.

A tentative computerized system is proposed, based on the analysis of climatic data and inoculum potential during 3 distinct consecutive periods :

(i) Climatic data are computerized daily, to provide informations on the climatic potential of the disease (PD 9 days, rank of incubation periods, infection days...). Some of these informations are general for all 3 periods, others are specific for each of them.

. forecast for climatic factors considered to be of importance for each period can be included daily, and their consequences for the potential of the disease are calculated,
. then, the climatic risk is rated (from 1 to 6).

(ii) The local inoculum is estimated according to the past history of the disease in the surroundings, and rated (from 1 to 5).

(iii) A combination of these ratings for these 3 periods allows a graded warning (no action, observation and pruning out of symptoms, spray) which remains to be adjusted to local conditions (varieties, growing conditions, vicinity of inoculum sources).

ATTEMPTS TO DEVELOP A BLOSSOM BLIGHT PREDICTION SYSTEM FOR THE APPALACHIAN FRUIT GROWING REGION. T. van der Zwet, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV, 25430; P. Steiner, Univ. of Maryland, Dept. of Botany, College Park, MD 20742; J. G. Barrat, West Virginia Univ. Experiment Farm, Kearneysville, WV 25430; K. D. Hickey, Penn. State Univ., Fruit Research Lab., Biglerville, PA 17307; and K. S. Yoder, Virginia Polytechnic Inst., Fruit Research Lab., Winchester, VA 22601.

Attempts to develop a blossom blight prediction system for the Appalachian fruit growing region are based on the application of existing fire blight risk assessment schemes dealing with degree days (Illinois), degree hours (California) and potential doubling of the causal organism (England) prior to and during bloom. All three methods are related to temperatures above 65°F (18.3°C). In 1984, temperatures during bloom were between 50-65°F (10-18.3°C), rainfall totalled .87 inches (23 mm) during 4 days, and in general no fire blight occurred except in a few isolated areas. In 1985, temperatures during bloom were between 60-85°F (15.6-29.4°C), there was no rainfall and moderate to severe fire blight occurred in most areas. Host-pathogen-weather conditions and disease occurrence for 1986 are being discussed in relation to the previous two years.

EPIDEMIOLOGICAL SURVEY OF FIRE BLIGHT DEVELOPMENT IN BELGIUM (1972-1985). Yves Timmermans. Laboratoire de Phytopathologie, Université Catholique de Louvain, Louvain-la-Neuve, Belgique.

For fifteen years, *Erwinia amylovora* has become endemic in all parts of the country where nurseries and orchards are of economic importance. In order to evaluate the actual situation of this bacteriosis, the general trends in the extension of fire blight have been studied, comparing meteorological data and the symptomatological records available. The period 1971-1978 was less dangerous than the following years on the basis of the Billing's potential doublings. The potentially most prone years for outbreaks seem to have been 1971 (if fire blight had already been present in Belgium), 1975, 1981, 1982 and 1985. This last season was in fact the worst one.

Since 1980 detailed records have been collected by several research centres from Durondeau pear orchards. They reveal that the symptom's peaks can be to some extent related with maximal temperatures and rainfall, but that discrepancies often arise, because other epidemiological factors overshadow the effect of weather. Therefore, research has been carried out in 1985 in order to make the host influence clear. The preliminary results show a direct relationship between various stages of plant phenology (as shoot length or secondary flowering) and symptoms'appearance.

PRIMARY INOCULUM FORMATION OF FIRE BLIGHT. T. Deckers and W. Porreye. Research Station of Gorsem (IWONL), B-3800, Sint-Truiden, Belgium.

A better understanding of the disease cycle of fire blight in the beginning of the season and of the formation of primary inoculum on the pear trees are very important factors for a good applicability of a warning system in this period.
Earlier publications (Beer, 1979 and Beer and Opgenorth, 1976) indicated that it was possible to isolate Erwinia amylovora bacteria from cancer surfaces and these bacteria are considered to be the primary inoculum. Infour experimental plots on pear trees, we observed heavy ooze formation on apical parts of the tree before any cancer activity could be found. Apical transport of Erwinia amylovora bacteria within the tree over longer distance is supposed.

BEHAVIOR OF ERWINIA AMYLOVORA ON LOW CHILLING PEARS IN THE CENTRAL REGION OF MEXICO. A. Mendoza and D. Teliz. Colegio de Postgraduados, Chapingo, Mexico - 56230.

Low-chilling pears have an especially long blossom period. In the central region of Mexico they bloom from September to January. In this region, fire blight was present in 90 per cent of the trees with a mean flower infection rate of 30 per cent. In 1983 and 1984, the mean temperature during the blossom periods was 18.5 C and 30% of the flowers became infected. In 1985, the mean temperature was 21 C and the flower infection rate was 50%.

NITROGEN NUTRITION AND SUSCEPTIBILITY OF PYRACANTHA "MOHAVE" TO FIRE BLIGHT (ERWINIA AMYLOVORA): A PRELIMINARY STUDY USING AN HYDROPONIC SYSTEM. Alain Cadic*, Francis Lemaire**, and Jean-Pierre Paulin***, Laboratoire d'Amélioration des Arbustes Ornementaux*; Station d'Agronomie**; Station de Pathologie Végétale et de Phytobactériologie**. Institut National de la Recherche Agronomique, Centre de Recherches d'Angers, Beaucouzé - 49000 Angers, France.

It is often considered that susceptibility to fire blight depends on the physiological condition of infected shoots. In this respect, mineral nutrition might play a part through its contribution to shoot growth and content. To check that hypothesis, Pyracantha "Mohave", an easy to propagate, fast-growing susceptible variety was chosen. Cuttings were rooted in aerated desionized water and then young plants were grown in nutrient solutions using hydroponic culture to avoid interactions which are likely to occur with solid substrates. In our preliminary study three nitrogen doses were used. Susceptibility was estimated by measuring the length of necrosis of inoculated shoots when physiological condition was caracterised both by shoot lengthening and nitrogen content of the different parts of cuttings. First results show a link between nitrogen rate in nutrient solutions, length of necrosis and nitrogen content of infected shoots. The experimental design can also be used to test any other element or nutrient combination.

DEHYDROGENASE AND CATALASE ACTIVITIES OF ERWINIA AMYLOVORA VARIANTS. ABO-EL-DAHAB, MOUSTAFA and FIRIAL HASSANEIN. Department of Plant Pathology, Faculty of Agriculture, Alexandria University, Alexandria, Egypt.

Dehydrogenase(s) and catalase activities of virulent (B), weakly virulent (C) and avirulent (A) isolates of Erwinia amylovora were determined. The three pathologically different variants of E. amylovora exhibited appreciable dehydrogenase activities when glucose, succinate, and citrate were used as substrates. While type A and B showed higher dehydrogenase activity than type C cells in presence of glucose, succinate and citrate, yet the observed differences could not be correlated with virulence. The tested types were variably able to decompose hydrogen peroxide. However, there were considerable variations in catalase activity among the tested Types B,C and A, showing high, moderate and low levels of catalase activities respectively. Such results may indicate possible positive correlation between catalase activity and virulence in E. amylovora.

STRUCTURE AND FUNCTION OF AMYLOVORIN AND ITS FRAGMENTS. R. Goodman, M. Gidley, and D. Butrov. Department of Plant Pathology, University of Missouri, Columbia, MO 65211 and Biopolymers Group, Unilever Research, Sharnbrook, Bedford, UK.

The composition and molecular configuration of amylovorin synthesized by Erwinia amylovora in planta and in vitro are identical. Equivalent wilt-inducing activity has been established for the parent molecule (10^8 daltons), a depolymerized fragment (2×10^4 daltons) and a dialyzable fragment ($6\text{-}8 \times 10^3$ daltons). The function of amylovorin is hypothesized to be biphasic, causing gel formation in xylem vessels that reflects crosslinking between amylovorin and vessel-wall polymers and, subsequently, causing electrolyte leakage and plasmolysis of xylem parenchyma cells.

POSSIBLE DETERMINANTS OF PATHOGENICITY OF ERWINIA AMYLOVORA
Richard M Cooper and David Youle, School of Biological Sciences, University of Bath, Avon, U.K.

Attempts are being made to isolate the causal factor(s) of bacterial or host origin of increased cell permeability in infected host tissues. Host cell electrolyte leakage and viability was assessed using immature pear fruit discs or suspension cultured apple cells. Virulent bacteria grown in the presence or absence of host tissues lost their capacity to induce cell leakage when killed by heat or streptomycin. The potentially toxic endo-polygalaturonidases are not produced by E.amylovora. EPS produced during growth on artificial media or with host tissue failed to induce electrolyte leakage; cell-free fluids from liquid cultures were also ineffective. However, sterile filtrates from the interaction between host tissue and either a virulent capsulated isolate (T) or an avirulent non-capsulated mutant capable of inducing cell leakage (E8) (but not from the capsulated avirulent isolate P) possessed toxic activity when concentrated 35-fold. Toxicity from culture salts was circumvented by performing the initial host-parasite interaction in deionized water. Division of concentrated fluids into high and low molecular weight fractions showed that only the latter was active. Ultrafiltration indicates the size of the 'toxin' is <1000 daltons. This is consistent with the need for any leakage-inducing agent to pass from intercellular spaces through the molecular sieve of the host cell wall matrix. Characterization and origin of the putative induced toxin are currently under investigation.

MUTANTS OF ERWINIA AMYLOVORA ALTERED IN PATHOGENICITY BY TRANSPOSON MUTAGENESIS. E. M. Steinberger and S. V. Beer, Department of Plant Pathology, Cornell University, Ithaca, NY 14853, USA.

The transposon Tn5 was used to create mutants of Erwinia amylovora strains Ea 321 and Ea 322 that are altered in their pathogenic capabilities. Twenty three prototrophic mutants have been generated using the plasmid pJB4JI or the lambda bacteriophage derivitive λ b_{221} CI_{857} rex::Tn5 as vectors for the transposon. Apple seedlings or immature pear fruits developed no disease symptoms following inoculation with the mutants. The growth rates of the mutants in plant tissue were similar compared to the wild types for at least the first 20 hours after inoculation. Extra cellular polysaccharide production in minimal broth medium was severely reduced in 19 of the 21 mutants. Southern blot analysis revealed nine mutants with distinct single-site insertions of Tn5 and 12 mutants with additional insertions of phage Mu, Tn5 or possibly IS50R. So far, only chromosomal insertions have caused alterations in pathogenicity. During the screening process for pathogenicity mutants, a derivative of Ea 322 was recovered that carried Tn5 in an indigenous plasmid of approximately 60 kb (pCPP60.1). This plasmid was shown to be conjugative and has been transferred to other E. amylovora strains and to Escherichia coli.

CLONING OF ERWINIA AMYLOVORA DNA RESPONSIBLE FOR PATHOGENICITY AND THE INDUCTION OF THE HYPERSENSITIVE REACTION. D. W. Bauer and S. V. Beer. Department of Plant Pathology, Cornell University, Ithaca, NY, 14853, USA.

Three Tn5-induced mutants of Erwinia amylovora have been identified that fail to induce a hypersensitive reaction (HR) in tobacco leaves. The three mutants are also nonpathogenic toward immature pear fruits. The Tn5-containing EcoRI fragment of DNA from one mutant, Ea 322-T101, was cloned in pBR322. The fragment was used to probe libraries of wild-type Ea 322 DNA constructed in pBR322 and pBR325. Three recombinant plasmids were found that weakly restored pathogenicity and induction of the HR when transformed into Ea 322-T101. One plasmid, pCPP120, containing a 16.3 kilobase EcoRI fragment of Ea 322 DNA was chosen for further study. pCPP120 was found to contain one or more genes that are deleterious to the growth of E. amylovora when present in high copy number. This may explain the poor complementation by pCPP120. pCPP120 was mapped with several restriction enzymes and a 4.5 kilobase SmaI fragment was subcloned in pGB2, a highly stable vector in E. amylovora. The resulting plasmid, pCPP130, completely restored pathogenicity and induction of the HR to Ea 322-T101; it was not deleterious to the growth of E. amylovora. Thus, one or more genes on the 4.5 kilobase fragment of DNA are involved in pathogenicity to host plants and the induction of the HR in a nonhost plant.

GENETICAL LABELLING OF pEA, A PLASMID FROM ERWINIA AMYLOVORA. Jacqueline Laurent, Marie-Anne Barny, and Alain Kotoujansky, Pathologie Végétale, INA-PG, 16 rue Cl. Bernard, F75231 Paris, Cedex 05, France.

Almost all the isolates of Erwinia amylovora that have been looked at, contain a cryptic plasmid called pEA which is 27.9 Kb in size. In an attempt to determine the role of this plasmid, we have undertaken genetic labelling of this plasmid, using the reverse genetic method deviced by Ruvkun and Ausubel (1). A fragment of pEA has been cloned in an E.coli vector and subsequently mutagenised by insertion of a Mu derivative. The labelled fragment was then introduced into E. amylovora by transformation. We have obtained now a strain containing only one genetically labelled pEA and its properties are under studies.

(1) G.B. RUVKUN and F.M.AUSUBEL (1981) Nature 289, 85-88

CLONING AND RESTRICTION MAP OF THE recA-LIKE GENE OF ERWINIA AMYLOVORA. J. L. Vanneste*, J. L. Norelli**, D. W. Bauer*, and S. V. Beer*. Departments of Plant Pathology, Cornell University, Ithaca*, NY 14853 and Geneva**, NY 14456, USA.

Genetic studies of the pathogenicity of E. amylovora require complementation experiments in which two homologous fragments of DNA must be present in the same strain. Stable isogenic mutants unable to undergo legitimate recombination (RecA$^-$ phenotype) would facilitate such studies. Thus, a genomic library of a wild-type strain of E. amylovora, Ea 322, was made in the RecA$^-$ strain of Escherichia coli HB101 using the plasmid vector pBR325. Clones harboring a recA-like gene were found using the pleiotrophic nature of the recA protein, which functions both in recombination events and as inducer of the DNA repair system. The E. coli clones containing the library were subjected to UV irradiation, and two plasmids conferring resistance to UV radiation were selected. In vitro deletions were created in one of these plasmids by partial digestion with the restriction endonuclease Sau3A. Mapping of the parental plasmid and derivatives, which either retained or lost recA-like activity, allowed the localization of the recA-like gene. The DNA fragment containing this gene has been mapped with respect to 13 restriction enzymes. These data will permit in vitro insertional inactivation of the recA gene. We plan to construct RecA$^-$ strains of E. amylovora using either the deleted or insertionally inactivated recA gene.

EVIDENCE THAT DERIVATIVES OF THE BACTERIOPHAGE MU CAN BE USED AS GENETIC TOOLS IN ERWINIA AMYLOVORA. J. L. Vanneste[1,2], D. Expert[1], and M. Faelen[2]. Pathologie Végétale[1], INA-PG, Rue Cl. Bernard 75231 Paris, Cedex 05, France. Laboratoire de Génétique[2], Faculté de Sciences. Université Libre de Bruxelles, Brussels, Belgium.

Several derivatives of the temperate bacteriophage Mu recently have been constructed. These are powerful genetic tools that permit among other uses: insertional mutagenesis, mapping by chromosome transfer, in vivo cloning and lac Z gene or protein fusions. The purpose of this work was to determine whether such Mu derivatives can be used in E. amylovora. The strain 1430 of E. amylovora was found sensitive to Mu particules having the G(-) host range, and infection resulted in stable lysogenic clones or in a lytic cycle leading to the production of virus particles. Further analysis indicated that Mu DNA inserts randomly into the E. amylovora chromosome: indeed among 2,200 lysogenic clones examined, 60 (2.7%) carried an auxotrophic mutation and a wide range of nutritional deficiencies were found. These results indicate that Mu derivatives can be used as genetic tools in E. amylovora. Further evidence was supplied by showing that pULB113, an RP4::mini Mu, can promote gene transfer from E. amylovora to Escherichia coli by R-prime derivative formation and can promote gene transfer by chromosome mobilization in homospecific matings.

USE OF A MU BACTERIOPHAGE DERIVATIVE TO CONSTRUCT MUTANTS OF ERWINIA AMYLOVORA ALTERED IN PATHOGENICITY. J. L. Vanneste*, J. P. Paulin** and D. Expert*. Pathologie Végétale*, INA-PG, Rue Cl. Bernard 75231, Paris, Cedex 05, France. INRA Centre de Recherches**. Agronomiques d'Angers Station de Pathologie Végétale, Beaucouzé 49000, Angers, France.

The defective derivative of Mu, (MudX): Mud, B^x::Tn9 (lac, Ap^r, Cm^r) constructed by T. A. Baker et al., [J. Bacteriol. 156:970 (1983)] was used to induce mutants of E. amylovora strain 1430 that are altered in pathogenicity. After infection of Ea 1430 with a lysate containing both MudX particles and Mu cts 62 particles, used as a phage helper, lysogenic clones were selected based on their resistance to chloramphenicol. Apple root callus was inoculated and incubated at 28°C to identify mutants altered in pathogenicity. At this temperature, the parental strain 1430 developed typical fire blight exudate within 3 days. Twelve mutants of 1400 examined, did not produced exudate or produced it only after 5 days. Moreover, two nonpathogenic mutants were also unable to induce the hypersensitive response when infiltrated into tobacco leave. The possibility that the genome of these mutants contained several transposable elements was investigated by Southern blot hybridization. Only one MudX prophage was present in distinct restriction fragments of five mutants. Four of the mutants showed differential sensitivity to one of 12 bacteriocins suggesting alterations in outer membrane components.

THE RELEASE AND ELECTRON MICROSCOPE VISUALISATION OF PLASMIDS IN ERWINIA AMYLOVORA USING AN IN SITU LYSIS TECHNIQUE. Mohamed El-Masry and David Sigee. Department of Botany, University of Manchester, Oxford Road, Manchester, UK.

A rapid procedure is described for the release and visualisation of plasmids in bacterial cells. The two-stage process, involving lysozyme treatment of cells in suspension, followed by in situ bursting by detergent on an electron microscope grid typically leads to initial release of plasmids followed by chromosomal DNA. Plasmids are of two main types - supercoiled and relaxed circles, with the latter showing membrane and protein associations. Treatment of freshly-liberated relaxed plasmids with trypsin or sodium dodecyl sulphate results in a stripping of associated macromolecules, producing circles of naked DNA. The effect of varying various experimental parameters is discussed, and the results obtained using Erwinia amylovora are compared to those obtained with other phytopathogenic bacteria.

ULTRASTRUCTURAL STUDIES ON FIREBLIGHT INFECTION OF HAWTHORN FLOWERS. Mark Wilson, Harry Epton and David Sigee. Department of Botany, University of Manchester, Oxford Road, Manchester. UK.

Flowers of Hawthorn (Crataegus monogyna) were artificially inoculated with the fireblight pathogen (Erwinia amylovora) in the laboratory, and progression of the disease monitored under maintained conditions of high humidity at 20°C. Scanning electron microscopy revealed a rapid multiplication of bacteria at the nectary surface, with many bacteria entering the external depression of the nectary pores (nectarthodes). Transmission light and electron microscopy showed that bacteria passed into the subnectarthodal spaces within 6h of inoculation, and by 48h had migrated across the top region of the nectary to the receptacle tissue, from where they spread to other regions of the flower. Rapid entry of bacteria into the anther tissue was of particular interest, with bacterial cells occurring in direct association with pollen grains within 1h after inoculation. Control inoculation of Hawthorn flowers with Erwinia carotovora lead to limited multiplication on the nectary surface, but complete lack of penetration into nectary and receptacle tissue.

THE USE OF ANTIBIOTICS TO CONTROL FIRE BLIGHT IN FRANCE: ENVIRONMENTAL RISKS AND ESTABLISHED LEGISLATION. Charles Manceau, Jean Pierre Paulin and Louis Gardan, INRA, Station de Pathologie Vegetale, Beaucouze, 49000 Angers, France.

Several untargeted effects of the use of antibiotics to control bacterial plant diseases of fruit trees were examined: The sensitivity to streptomycin for the person who performed the treatment by spraying and the modification of his intestinal microflora; the control of the persistence of streptomycin on pear and apple leaves and fruits; the increasing of resistance of targeted bacterium; the control of the unbalance of natural leaf microflora associated with pear trees; the investigation of R plasmid among the epiphytic bacteria; and the dynamic of transfer of RP4 plasmid between Xanthomonas campestris pv. corylina and Erwinia herbicola, in planta. Leaning partly on this study, the authorization of using flumequine was conceded to control the fire blight on pear and apple trees only. Legislation was established stipulating the conditions of selling and the control of the development of resistance in Erwinia amylovora in commercial orchards. No control of the selection and spreading of R plasmid was provided in the decree since no plasmid encoded flumequine resistance was observed.

STRATEGY FOR FIRE BLIGHT CONTROL ON PEARS UNDER NATURAL INFECTION CONDITIONS. T. Deckers*, J. Geenen**, and W. Porreye*. Research Station of Gorsem (IWONL)*, B-3800, Sint-Truiden, Belgium. Rijksstation voor Plantenziekten**, B-9220, Merelbeke, Belgium.

Efficiency of different chemical compounds against fire blight in comparison with Streptomycine was examined in greenhouse experiments, with artificial inoculation of Erwinia amylovora on growing shoots of young trees of the pear variety Durondeau/quince A rootstock.
In orchard trials (pear c.v. Durondeau/quince, adult trees) the effect of a combination of the use of chemical compounds (Copac E, Streptomycine, MBR 10995) and phytotechnical measures is discussed : pruning away secondary blossoms, limiting the growing period of the shoots in the season and avoiding regrowth reactions later in the season.
The results indicate that chemical control gives good results in the control of fire blight, but optimal control is achieved when they were combined with some phytotechnical measures destinated to reduce both host susceptibility and bacterial inoculum.

DISINFESTATION OF PRUNING SHEARS TO PREVENT FIRE BLIGHT TRANSMISSION. H. Kleinhempel and M. Nachtigall. Institut fur Phytopathologie, Theodor-Roemer-Weg 4, 432 Aschersleben. German Democratic Republic.

The scanning-electron microscope was used to examine the cutting edges of tools used to prune fire blight infections. The investigation was prompted by observations that chemical disinfestants are deficient in eliminating the contamination that results after cutting infected tissues. Cells of the fireblight bacterium, Erwinia amylovora, located in the smallest crevices and cavities of the shears, apparently were not contacted by the disinfestants. When the cutting surfaces of pruning shears were coated with thin plastic layers, several disinfestants proved satisfactory for inhibiting transmission of E. amylovora.

ORCHARD EVALUATION OF FIVE STRAINS OF ERWINIA HERBICOLA FOR CONTROL OF BLOSSOM INFECTION. S. V. Beer*, J. R. Rundle*, and J. L. Norelli**. Departments of Plant Pathology, Cornell University, Ithaca*, NY 14853 and Geneva**, NY 14456, USA.

Five strains of Erwinia herbicola that appeared most promising in earlier experiments were tested for their ability to control the blossom blight phase of fire blight in the research apple orchard. Each strain was grown in dilute nutrient-yeast extract-glucose broth to late log phase. Suspensions were diluted in tap water to ca. 1×10^8 colony forming units (cfu) per ml and sprayed on blossom clusters of 'Idared' apple. A water check and streptomycin (100 mg/ml) were also included. Each treatment was applied to eight trees situated in randomized complete blocks. The first application was made when ca. 75% of the blossoms were open. One day later at full bloom, the same blossom clusters were inoculated with ca. 2×10^7 cfu/ml of E. amylovora. A second application of the test treatments was made later on the same day. In the water (control) treatment, 26% of the clusters became infected. The bacterial treatments reduced infection by an average of 57%, and did not differ significantly from each other. Streptomycin reduced infection by 84%, which was significantly greater control than that provided by two of the bacterial strains. Low infection in the water control compared to previous years was likely due to the cool dry conditions following inoculation.

POPULATION DYNAMICS OF ERWINIA AMYLOVORA AND A BIOLOGICAL CONTROL AGENT, ERWINIA HERBICOLA ON APPLE BLOSSOM PARTS. J. R. Rundle and S. V. Beer. Department of Plant Pathology, Cornell University, Ithaca, NY 14853, USA.

Apple blossoms sprayed with suspensions of E. herbicola or E. amylovora in a growth chamber were colonized to populations of 10^6 to 10^7 colony forming units (cfu) per blossom in 24 hours. At least 90% of the cfu were recovered from the stigmas; 10^4 to 10^5 cfu were recovered from other flower parts. Erwinia herbicola populations remained nearly constant in all flower parts for up to five days. Erwinia amylovora populations on stigmas continued to rise, while styles became progressively colonized, followed by the calyx. When E. herbicola, Eh 252 a biocontrol agent of fire blight, was sprayed on blossoms 24 hours before inoculating with E. amylovora, the initial population of the pathogen on the stigma (10^4 cfu) dropped to a constant 10^3 cfu; the styles did not become colonized by the pathogen. Calyx populations were variable, but some direct suppression of the pathogen by E. herbicola seemed to occur there. The data suggest that strains of E. herbicola that control fire blight suppress E. amylovora on the stigmas, thereby preventing the progressive invasion of the style. Strains that are high in effectiveness as biocontrol agents did not grow at a faster rate or to a higher level on stigmas than strains that are low in effectiveness.

ATTEMPTS TO FIND THE MECHANISM BY WHICH ERWINIA HERBICOLA INHIBITS ERWINIA AMYLOVORA. R. S. Wodzinski, T. E. Umholtz, K. Garrett and S. V. Beer*, Biology Department, Ithaca College, Ithaca, NY, 14850, USA. Department of Plant Pathology*, Cornell Univerasity, Ithaca, NY, 14850, USA.

Erwinia herbicola 252 (Eh 252), Eh 246, and Eh 159 are highly effective, moderately effective, and weakly effective antagonists of Erwinia amylovora 273 (Ea 273), respectively, in field tests. When Eh 252 was grown together with Eh 246 or Eh 159 in the same pear, all strains grew at the same rate. These data do not support the previously proposed hypothesis that E. herbicola inhibits E. amylovora by depleting the nitrogen sources required for the growth of E. amylovora. Different E. herbicola strains were grown to stationary phase in a glucose-asparagine medium, and then removed from the medium. When the medium was supplemented with asparagine, which was depleted in the medium by the growth of the E. herbicola, the growth of Ea 273 was inhibited. However, Ea 273 grew in medium that had not previously supported the growth of E. herbicola. The degree of inhibition of the growth of Ea 273 in medium that previously supported the growth of different strains of E. herbicola correlated well (in four of five cases) with the effectiveness of the E. herbicola strains in preventing Ea 273 infections of apple blossoms in field tests. Thus, toxin production may be important in the mechanism by which E. herbicola inhibits E. amylovora.

THE EFFECT OF OSMOTIC CONCENTRATION ON THE PRODUCTION OF HERBICOLACIN 112Y BY ERWINIA HERBICOLA 112Y. R. S. Wodzinski, G. Stegner, S. V. Beer*, and P. Sobiczewski**. Biology Department, Ithaca College, Ithaca, NY, 14850, USA. Department of Plant Pathology*, Cornell University, Ithaca, NY, 14850, USA. Research Institute for Pomology and Floriculture**, 96-100 Skierniewice, Poland.

Erwinia herbicola 112Y (Eh 112Y) sometimes produces a bacteriocin, called herbicolacin 112Y (H-112Y), that inhibits the growth of Erwinia amylovora, the fire blight pathogen. Herbicolacin 112Y was not produced when Eh 112Y was grown on a glucose-mineral salts medium with complex nitrogen sources. Addition of nutrient broth, yeast extract, casamino acids, or a combination of nutrient broth and yeast extract inhibited production. However, H-112Y was produced in the same media when the concentration of potassium phosphate was 0.18M. Production of H-112Y was stimulated when the concentration of NaCl was 0.5M or the concentration of sorbitol was 1.0M. Thus, high osmotic concentration in broth media stimulated H-112Y production. It was found that the high osmotic concentration stimulated H-112Y production and did not simply cause the release of H-112Y that adhered to cell components.

CHEMICAL CONTROL OF FIRE BLIGHT ON CIDER APPLE, 1985. David R. Jones* and Robert J.W. Byrde**. MAFF/ADAS Plant Pathology Department*, Burghill Road, Westbury-on-Trym, Bristol BS10 6NJ, UK. Department of Agricultural Sciences**, University of Bristol, Long Ashton Research Station, Bristol BS18 9AF, UK.

In a trial of six chemical treatments applied twice weekly during bloosom on the late-flowering cider apple cv. Vilberie, the mean number of fire blight strikes/tree was 142 on untreated trees. Streptomycin (100 ppm a.i.) and the experimental bactericide Sumitomo S.0208 (300 ppm a.i.) decreased infection by 90% and 99% respectively. Both increased yield significantly, by 20% and 27% respectively. Other treatments were less effective.

74

SOME RESULTS OF FIELD EXPERIMENTS ON THE CONTROL OF FIRE BLIGHT. Jean Pierre Paulin, Gerard Lachaud and Roland Chartier, INRA, Station de Pathologie Vegetale, Beaucouze, 49000 Angers, France.

The preventive spraying of three antibiotic compounds, one avirulent strain of Erwinia amylovora and two copper compounds were compared for the efficience to reduce fire blight injury on Pyrus communis L. var Pierre Corneille blossoms under field conditions. Streptomycin (Agrimycin) and flumequin (MBR-3M) provided a good control such as less than 4% infected blossoms were recovered. The avirulent strain 1376 of E. amylovora and the other antibiotic compound (Kazugamycin) provided a medium control (about 25% infected blossoms). Both copper compounds, Bordeaux mixture (RSR) and cupric hydroxide (Kocide) did not provide more reduction of blossom infections than the water sprayed trees (more than 30% infected blossoms). The unusually low performance of copper compounds was probably due to low temperatures recorded during the experiment (April 1985).

DISINFESTANTS FOR TREATING PRUNING SHEARS USED FOR FIRE BLIGHT INFECTIONS. S. V. Beer and J. R. Rundle, Department of Plant Pathology, Cornell University, Ithaca, NY 14853, USA.

The recent availability of pruning shears equipped with a semi-automated system for treating the cutting edges with a disinfestant (Felco 8P; Switzerland) prompted an investigation of possible disinfestants for use in the system. Preliminary testing was done by dipping a scalpel in suspensions of Erwinia amylovora and then in one of three disinfestants: ethanol (70% v/v) isopropanol (70% v/v) and sodium hypochlorite (0.05% w/v). All the tested disinfestants reduced the number of colony forming units (cfu) of E. amylovora recoverable from 10^6 cfu/blade to less than 10^2 cfu/blade. There were no detectable differences in the effects of the three materials. Based on its efficacy, noncorrosive nature and wide availability, 70% ethanol was selected for further testing with the actual shear system. Infected immature pear fruits, previously inoculated with E. amylovora, Ea 273, were cut with the pruning shears and then treated with 70% ethanol either by dipping for 2 seconds or by spraying the blades using the built-in sprayer. Dipping the blades in ethanol resulted in a 10,000-fold reduction in recoverable E. amylovora; spraying resulted in a 100-fold reduction. When fresh immature pear fruit were cut with contaminated shears, all developed infection. Using the built-in sprayer, only 50% of the cut pear fruits became infected; dipping in ethanol (70%) resulted in the complete elimination of effective inoculum.

NATURAL POPULATIONS AND SURVIVAL OF AN INTRODUCED STRAIN OF ERWINIA HERBICOLA ON APPLE. R. S. Wodzinski, P. Sobiczewski* and S. V. Beer**. Department of Biology, Ithaca College, Ithaca, NY 14850 USA; Research Institute for Pomology and Floriculture*, 96-100 Skierniewice, Poland; Department of Plant Pathology**, Cornell University, Ithaca, NY 14853 USA.

Erwinia herbicola 112Y (Eh 112Y) was sprayed on the leaves of Idared apple, and the population recoverable at subsequent times was determined by plating. During the first 24 hr after application, marked decreases in the recoverable populations were observed in all trials done on 10 different dates during the growing season. From 1 to 11 days, the surviving population generally fluctuated from 10^2 to 10^4 CFU (colony forming units) of Eh 112Y per g of leaves. The Eh 112Y populations from 22 to 122 days after application were generally under 10^3 CFU per g of leaves. The Eh 112Y survived on blossoms far better than on leaves; the decrease in population was much less in the first 24 hr and the surviving population from 1 to 11 days after application of bacteria was generally from 10^5 to 10^7 CFU per g of blossoms. Natural populations of E. herbicola on the leaves of Idared and McIntosh, determined throughout the growing season, ranged from 0 to 3500 CFU per g of leaves.

EVALUATION WITH DIFFERENT ISOLATES OF ERWINIA AMYLOVORA OF THE SUSCEPTIBILITY TO FIRE BLIGHT OF 9 APPLE CULTIVARS. J. P. Paulin* and Y. Lespinasse**. INRA, Station de Pathologie Végétale*, 49000 Angers, France. [2]INRA, Station d'Amélioration des Plantes**, 49000 Angers, France.

Nine apple cultivars of known susceptibility (CHANTECLERC, EVERESTE, FLORINA, GOLDEN DELICIOUS, GRANNY SMITH, IDARED, MELROSE, NOVOLE) have been shoot-inoculated with four strains of **E. amylovora** of different origins, including strains 266 and 273 (from NORELLI **et al**, 1983).

Results of these inoculations are used : (i) to propose the most convenient and reliable disease index to assess the susceptibility of an apple cultivar, (ii) to compare the classification of the varieties obtained with each strain.

EVALUATION AND SELECTION OF FIRE BLIGHT RESISTANCE IN APPLE WITH REFERENCE TO DIFFERENTIAL VIRULENCE IN ERWINIA AMYLOVORA. John L. Norelli, Herb S. Aldwinckle, Steven V. Beer *, and Robert C. Lamb **. Departments of Plant Pathology and Horticultural Sciences **, Cornell University, Geneva, NY, 14456 and Ithaca *, NY, 14850, USA.

The development of apple scion and rootstock cultivars with multiple disease resistance, including fire blight resistance, is an objective of the apple breeding program at the New York State Agricultural Experiment Station, Geneva. Differential host X pathogen interactions occur among some of the sources of fire blight resistance used in the breeding program and strains of E. amylovora (Ea). Seedlings from controlled crosses are inoculated in the greenhouse with a mixture of highly aggressive Ea strains which includes strains differentially virulent and avirulent on 'Novole'. This inoculation identifies susceptible seedlings that can be discarded before being tested further in the field. After initial pomological evaluation, selections of interest are inoculated again with several individual Ea strains. Although mixed inocula have proven effective for preliminary evaluation of fire blight susceptibility, differential susceptibility to specific Ea strains only can be detected by inoculation with individual strains.

COMPARISON BETWEEN TWO METHODS OF SELECTION FOR RESISTANCE TO ERWINIA AMYLOVORA IN YOUNG SEEDLINGS OF PEAR. Bernard Thibault*, Pascal Lecomte**, Léonce Hermann*, and André Belouin*. Station de Recherches d'Arboriculture Fruitière*. Station de Pathologie Végétale et Phytobactériologie**. Institut National de la Recherche Agronomique, Centre de Recherches d'Angers, Beaucouzé - 4900 Angers, France.

Ten parents were crossed with the old french variety 'Pierre Corneille' (Pyrus communis) in order to found a pear variety not too susceptible to fire blight. The ten parents were

a) european varieties,
b) U.S. varieties,
c) U.S. and Canadian selections.

This ten parents and the common parent 'Pierre Corneille' were all previously observed in State or Canada for their low susceptibility.

The progenies were divided in two parts and the selection for resistance was performed according to two ways :

1) in glasshouse after inoculation on young seedlings in their first year of growing, on only one shoot.

2) in the orchard, after inoculation of fifteen shoots (5 shoots x 3 years) on 3 to 5 years old seedlings.

The two methods are compared taking as criteria the index of susceptibility (Severity x Frequency) and the rate of selection.

IN VITRO CULTURE AS A TOOL FOR THE EVALUATION OF FIRE BLIGHT RESISTANCE IN PEARS AND APPLES. J. Viseur. Faculté des Sciences Agronomiques, Centre de Lutte Integrée en Phytopathologie, 5800 Gembloux, Belgium.

A new method has been tested to determine the degree of fire blight resistance in pears and apples by artificial inoculation of plantlets produced in vitro. Shoots, 2-3 cm long, obtained through micropropagation were inoculated by cutting an apex leaf with scissors dipped in a suspension of virulent Erwinia amylovora. Symptoms obtained in vitro were similar to those observed in the field : blight, necrosis of shoots, petioles and leaves, ooze production. A strain of E. amylovora which was avirulent under natural conditions did not induce any symptoms when inoculated in vitro. The experimental conditions used (culture medium, light, temperature, inoculum) influenced the level and uniformity of symptoms. After optimalisation of the test, we compared the resistance levels of 13 pear and 7 apple cultivars. A good correlation was observed between the degree of blight resistance shown in vitro by any pear cultivar, and its field resistance as reported by different authors for the same genotype. Twelve days after inoculation of pear plantlets with E. amylovora, the field-sensitive cv "Durondeau" and cv "Doyenné du Comice" reached mortality levels of 92% and 88%, respectively, whereas the less susceptible cv "Old Home X Farmingdale N°51" showed only 9% mortality. For apple under similar conditions, more than 90% mortality was observed for cv "Golden delicious" and rootstock "M.26", while values less than 10% were obtained for cv "Perpetu ® Evereste", "Jubile ® Delgollune" and rootstock "M.M. 111".

AN ASSAY FOR THE VIRULENCE OF ERWINIA AMYLOVORA USING MALUS TISSUE CULTURE. John L. Norelli, Herb S. Aldwinckle and Steven V. Beer, Departments of Plant Pathology, Cornell University, Geneva, NY 14456 and Ithaca, NY, 14850, USA.

A rapid, efficient method to determine the virulence of strains of E. amylovora (Ea) on Malus 'Novole' has been developed. Shoot tip cultures of 'Novole' are propagated, rooted and inoculated in vitro. Rooted, 1- to 3-cm long plantlets are inoculated by dipping scissors in a suspension of Ea (10^8 cfu/ml) and then bisecting one or more leaves. Fourteen days later, plantlets inoculated with Ea strain 266 (virulent on 'Novole') show typical fire blight symptoms including necrosis and watersoaking; plantlets inoculated with Ea strain 273 (avirulent on 'Novole' but virulent on most other apple cvs.) show no fire blight symptoms. When several strains of Ea were assayed for their virulence on 'Novole' there was a positive correlation between data obtained from the in vitro assay and from inoculation of 'Novole' grown in the greenhouse. The in vitro assay was used to screen 143 field isolates from North America, Europe, and Egypt for virulence. Fifteen strains from the eastern and central US, and Canada were virulent on 'Novole'.

SUSCEPTIBILITY OF RED-FRUITED PEAR CULTIVARS TO FIRE BLIGHT. David Sugar and Phil VanBuskirk, Oregon State University, Southern Oregon Experiment Station, 569 Hanley Road, Medford, OR 97502; and Tom van der Zwet, USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430.

Red-fruited pear cultivars, which are of increasing commercial importance in the pear industry of the northwestern United States, were evaluated for relative susceptibility to fire blight and horticultural characteristics which may affect disease incidence. Budwood of 15 of the most popular cultivars was sent to West Virginia and propagated on Bartlett seedling understock. Tips of actively growing shoots were needle-inoculated in the greenhouse with a bacterial suspension of a mixture of 3 strains of Erwinia amylovora at approximately 10^8 cells/ml. Similar inoculations were performed on shoots of mature orchard trees in Oregon. Progress of shoot infections were measured. Trees of each cultivar were characterized as to vigor and tendency to produce late, secondary bloom in southern Oregon.

DEGREE OF FIRE BLIGHT RESISTANCE OF PEAR SELECTIONS AND CORRELATIONS BETWEEN GREENHOUSE AND ORCHARD INOCULATIONS. Bell, R. L., and T. van der Zwet. USDA, ARS, Appalachian Fruit Research Station, Kearneysville, WV 25430, USA.

Shoot tips of 5 or 10 greenhouse-grown single shoot trees and 5 shoots on each of 2 orchard-grown trees were inoculated using a hypodermic syringe with a mixture of two strains of Erwinia amylovora (Ea 273 and Ea 266). Six cultivars and 32 selections were evaluated for resistance/susceptibility on the basis of mean length of shoot blighted, percent length of shoot blighted, the corresponding rates of blight development, proportion of blighted shoots, and index of varietal susceptibility (IVS). Correlations between these measures were computed for trees inoculated in the same environment (greenhouse and orchard); correlations between greenhouse and orchard inoculation results were computed.

BREEDING WOODY ORNAMENTALS FOR FIRE BLIGHT RESISTANCE

Anna Sophie Bouma
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In 1975 a breeding program for fire blight resistance of Pyracantha and Cotoneaster was started by collecting cultivars and species and testing them for fire blight resistance.
At the same time crosses were made between the cultivars and later on the seedlings of the crosses were teated in a greenhouse by artificial infection. The next stage in the breeding program is selecting in a trial field with a high natural infection pressure.
Also other characteristics, like e.g. winter hardiness, scab susceptibility and plant habitus, are evaluated there. The results of the program until 1985 will be diacussed.
For Crataegus another way was followed. From botanical gardens seeds were collected; these seedlings were tested in the greenhouse.
The species showed different fire blight susceptibility, the remaining healthy plants were planted in the trial field. During the research also methods were developped for improving the seed germination.

POSTER REPORT

BREEDING PYRACANTHA FOR DISEASE RESISTANCE.

Alain CADIC

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A breeding program started in 1982 to obtain new varieties resistant to Scab (Fusicladium Pyracanthae) and to Fire blight (Erwinia amylovora). Since that time, 33 clones were selfed and hybridised in 126 combinations. Differences among progenies were observed either with scab or fireblight susceptibility. Oldest progenies were shoot inoculated in the field ; some hybrids, mainly from P. "Shawnee" x P. Atalantioides "Mozart" are promising. Fireblight testing will be continued ; in the same time first selections will be dispatched to some french nurseries for further observations (ornamental value, hedging ability ...).

ASSESSMENT OF THE SUSCEPTIBILITY TO ERWINIA AMYLOVORA OF 90 VARIETIES OR SELECTIONS OF PEAR. Bernard Thibault*, Pascal Lecomte**, Léonce Hermann*, and André Belouin*. Station de Recherches d'Arboriculture Fruitière*. Station de Pathologie Végétale et Phytobactériologie**. Institut National de la Recherche Agronomique, Centre de Recherches d'Angers, Beaucouzé - 4900 Angers, France.

A collection of 70 varieties of Pear and 20 U.S. or Canadian Selections was artificially inoculated on shoots in the experimental orchard of DAX.

Two inoculations were carried out, one in 1984 (12 to 40 shoots by genotype) and one in 1985 (24 shoots).

The results are presented in diagrams where the severity is in absciss and the frequency in ordinate.

Some genotypes as KIEFFER or HW 605 show a high frequency but a somewhat low severity. On the other hand 'Beurré Hardy' shows a low frequency but a high severity.

An other point is the stability of the classification for the varieties with a low or a high susceptibility and the variability for the varieties with medium susceptibility. The responses were generally more severe in 1985 than in 1984.

SHOOT AND BLOSSOM SUSCEPTIBILITY TO FIRE BLIGHT OF AMERICAN AND EUROPEAN APPLE CULTIVARS. Marcel Le Lezec*, Jean-Pierre Paulin**, and Pascal Lecomte**. Station de Recherches d'Arboriculture Fruitière*, and Station de Pathologie Végétale et Phytobactériologie**; Institut National de la Recherche Agronomique, Centre de Recherches d'Angers, Beaucouzé - 49000 Angers, France.

The fire blight susceptibility of 75 named cvs. of domestic apple and of two Malus species have been evaluated by artificial inoculation, during 3 or 4 consecutive years for shoot inoculation, and 2 consecutive years for flower inoculation. The results of shoot inoculation are assessed by varietal susceptibility index (V.I.S.) of 5 classes (0-20), (20-40), (40-60), (60-80), (80-100) where V.I.S. = length-of-necrosis/length-of-inoculated-shoot x 100, which takes into account the proportion of blighted shoots, and the progression of the disease after inoculation (Le Lezec, M., and Paulin, J. P., 1984). The results of flower inoculations are assessed in 5 classes (same limits as above) which are the actual percentage of infected blossoms after inoculation (Varietal Receptivity). A table shows the rating of the cvs. and spp. according to these two assessments. The correlation between the two indexes is usually poor (r ranges from 0.25 to 0.48). Nevertheless, it appears that this classification fits with the rating of field susceptibility as previously assessed in the same conditions, with few exceptions. The relations between different ratings are discussed.

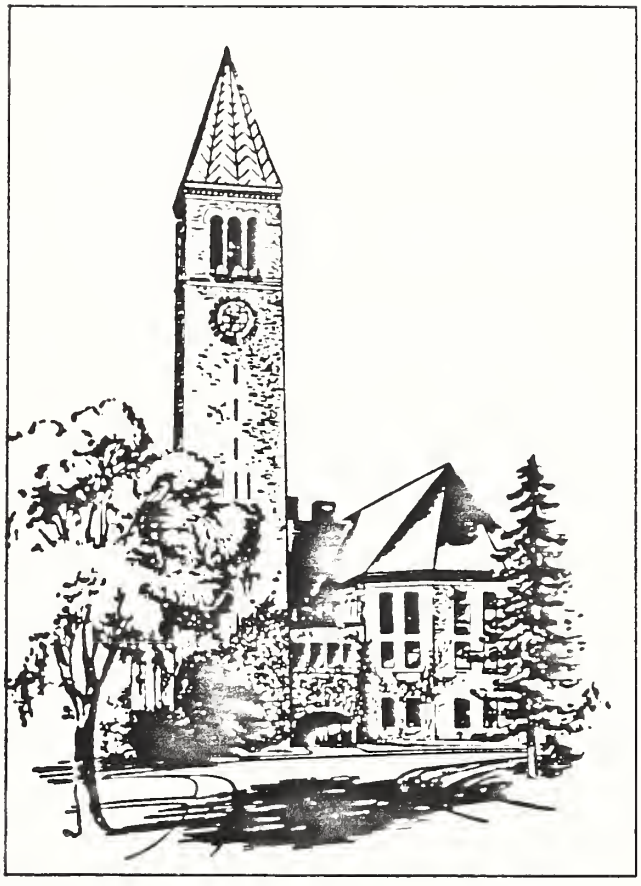
THE USE OF IN VITRO PROPAGATED MICROCUTTINGS FOR RATING FIRE BLIGHT SUSCEPTIBILITY OF PEAR AND APPLE. M. Duron*, J. P. Paulin**, and M. N. Brisset**. INRA, Station d'Arboriculture Fruitière*, 49000 Angers, France. INRA, Station de Pathologie Végétale**, 49000 Angers, France.

It may be decisive to use **in vitro** propagated microcuttings, especially when high number of individuals are to be tested e.g. for screening after treatement inducing mutation or somaclonal variation.

Inoculations of wounded leaves of **in vitro** plantlets by **Erwinia amylovora** give the same symptoms than in field : ooze production and necroses, provided suitable conditions are gathered. The less time consuming and the most reliable method of inoculation in our hands seems to be the following : pichs of leafblade with a dessecting holder previously dipped into a bacterial suspension. According to the severity of the symptoms on index (NSI) has been devised.

The influence of different factors have been investigated, among them inoculum concentration and growing conditions of microcuttings (e.g. temperature after inoculation (15 - 20 - 28°C) doesn't influence significativety the response of the plantlets but illumination conditions do.

In vitro rating of NSI shows a differential behaviour of resistant and susceptible varieties, then allowing the rapid screening of mutants or variants, even in large quantity.



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Wilcox, W. F., Dept. of Plant Path., N.Y. State Agric. Expt. Sta., Geneva, New York 14456. (315) 787-2335 (2) USA

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Zutra, D., Department of Plant Pathology, Agricultural Research Organization, The Volcani Centre, Bet Dagan 50250, Israel (972-03.980.535) (1) ISR

Zwet, T. van der, U.S. Department of Agriculture, Appalachian Fruit Research Station, Rt. 2, Box 45, Kearneysville, West Virginia 25430 (304-725-3451, ext. 29) (1) USA

Working Group Membership by Country 1/

Argentina	Bergna, D. A.	*Meyer, F. C.
	Dobra, A.	
Australia	*Cartwright, D. N.	Sampson, P. J.
	Fahy, D. C.	Wimalajeewa, S.
Austria	*Keck, M.	
	Vukovits, G.	
Belgium	Deckers, T.	*Porreye, W.
	De Ley, J.	Timmermans, Y.
	Geenen, J.	Vantomme, R.
	Laere, O. van	Veldeman, R.
	Laroche, M.	Vereecke, M.
	Luchene, K. van	Vermaerke, D.
	Maroquin, C.	Viseur, J.
Brazil	Bredemeier, D.	
	Feliciano, A. J.	
Canada	AGR. CAN. LIBRARY	Lane, D.
	Biggs, A. R.	Lethal, J.
	*Bonn, W. G.	*Lockhart, C. L.
	Cline, R. A.	McPhee, R.
	Coulombe, L. J.	Muir, J.
	Davidson, J. G. N.	Quamme, H.
	*Evans, I. R.	Rousselle, G. L.
	Gibbins, L. N.	*Sholberg, P.
	Howard, R. J.	*Stushnoff, C.
	Hunter, C. L.	Yorston, Y. M.
	Kappel, F.	
China (P.R.)	*Cao, R.	
	Zhang, Z.	
Cyprus	*Dimova, M.	
Czechoslovakia	*Kudela, V.	Vondracek, J.
	Paclt, J.	
Denmark	Anderson, H.	Kristensen, H. R.
	Christensen, F. G.	Mosegaard, J.
	*Dinesen, G.	Simonsen, J.
	Jorgensen, H. A.	
East Germany (DDR)	*Kleinhempel, H.	Vogelsanger, D.
	Muller, H. J.	
Egypt	*Abo-El-Dahab, M. K.	Stino, G. R.
	El-Kazzaz, M. K.	

1/ Names with asterisk (*) are contact persons.

England (U. K.)	Alston, F. H.	Hignett, R. C.
	Billing, E.	Jones, D. R.
	Byrde, R. J. W.	Mansfield, J. W.
	Cooper, R. M.	Rowson, G. R.
	Ebbels, D. L.	Smith, A. R. W.
	Epton, H. A. S.	Stead, D.
	Evans, E. G.	Tanaka, K.
	Fox, R. T. V.	Taylor, D.
	*Garrett, C. M. E.	
France	Balavoine, P.	Michon, P.
	Cadic, A.	*Paulin, J. P.
	Chevalier, R.	Smith, I.
	Larue, P.	Thibault, B.
	Lecomte, P.	
Greece	Panagopoulos, C. G.	Tsiantos, J.
	*Psallidas, P. G.	
Hungary	Klement, Z.	*Simon, E.
	Nemeth, J.	Valyi, S.
India	Gupta, V. K.	
	Sharma, V. P.	
Ireland	*Walsh, P.	
Israel	*Shabi, E.	
	Zutra, D.	
Italy	*Bazzi, C.	Garibaldi, A.
	Calzolari, A.	Mazzucchi, U.
	Casano, F.	Oberhofer, H.
	Ercolani, G. L.	Quarta, R.
	Fideghelli, C.	Waldner, W.
Japan	Asao, S.	Kato, T.
	*Fujita, K.	Nishimura, H.
	Goto, M.	Okuse, I.
Mexico	*Fucikovsky, L.	Nuncio, O.
	Mendoza H., A.	
Morocco	Benjama, A.	
	*Chouibani, M.	
Netherlands	Bouma, S.	PUDOC
	CHRONICA HORTIC.	Scheer, H. A. T. van der
	Heybroek, H. M.	Schouten, H. J.
	Janse, J. D.	*Teylingen, M. van
	Kooistra, T.	Vuurde, J. W. L. van
	Meijneke, C. A. R.	
New Zealand	Dye, D. W.	Young, J. M.
	*Hale, C. N.	

Norway	Dale, T. *Sletten, A.	
Poland	Burkowicz, A. *Sobiczewski, P.	
Portugal	Jacob, C. *Martins, J. M. S.	
Romania	Parnia, P. Severin, V.	*Suta, V.
Russia (USSR)	*Voronkova, L.	
South Africa	Goodman, C. A. *Hattingh, M. J.	Schwabe, W. F. S.
Spain	Lopez Gonzales, M. Mansergas, A. J. F. *Noval, C.	Palazon, I. Robert, P. Sanchezmonge, E.
Sweden	*Graberg, M. Kroeker, G.	Persson, P.
Switzerland	Aleando, Z. Bolay, A. Cazelles, O.	Egli, T. *Grimm, R. Joseph, E.
Taiwan	*Lin, C. P.	
Turkey	Baykal, N.	
West Germany (BRD)	Baumm, L. H. Franz, W. Gessner, E. Graf, H. Hoppe, H. Knosel, D. Kuck, K. H. Kuhne, H. Lehmann-Danzinger, H. Lux-Wellenhof, E.	Mappes, D. Massfeller, D. Meyer, J. Michel, H. G. Persiel, F. Prillwitz,H. G. Rudolph, H. G. Schilli, E. Schulz, F. A. *Zeller, W.
Yugoslavia	Arsenijevic, M. Markovic, S.	Ristevski, B. *Stankovic, D.

UNITED STATES

Aldwinckle, H. S.
*Barrat, J. G.
Bates, J. J.
*Beer, S. V.
Bell, R. L.
Berry, D. W.
Beutel, J. A.
Biehn, W.
Burr, T. J.
Bushong, J. W.

Cameron, J. R.
Carlson, R. F.
Carroll, V. J.
Chandler, D.
Civerolo, E. L.
Clayton, C. N.
Close, T. J.
*Covey, R. P.
Crassweller, R.
Cummins, J. N.

Davidson, S.
*Douglas, S. M.
Drake, C. R.
Egolf, D. R.
*Ellis, M. A.
French, J. R.

Gantotti, B. V.
Gates, D.
*Goodman, R. N.
Harnish, W.
Heimann, M. F.
*Hickey, K. D.

*Janick, J.
Johnson, D. E.
*Jones, A. L.
Kado, G. I.
Klos, E. J.
Koenigshof, R.
Kuc, J.
Kyle, N. E.

Lacy, G. H.
Lamb, R. C.
Landis, W. R.
Lombard, P. B.

McSwan, I. C.
Mielke, G.
*Miller, R. W.
Morehead, G. W.
Morton, H. V.
Norelli, J. L.

Opgenorth, D. C.
Otterbacher, A.
Pecknold, P. C.
Preczewski, J. L.
*Preiser, F.

Rackman, R. L.
*Ries, S. M.
*Ritchie, D. F.
Rom, R. C.
Rosenberger, D. A.
Ryugo, K.

Sands, D. C.
Sasser, M.
Schafer, T. W.
Schroth, M. N.
Seem, R. C.
Singh, B. P.
*Slack, D.
Smith, T. J.
Spotts, B. P.
Starr, M. P.
*Steiner, P.
*Sugar, D.
Sumida, T.
Sutton, T. B.
Swanson, B. T.

*Thompson, J. M.
*Thomson, S. V.
Travis, J. A.
Van Buskirk, P. D.
*Wade, E. K.
Westwood, M. N.
Wilcox, W. F.
Willett, M.
Wodzinski, R. S.

*Yoder, K. S.
Zehr, E. I.
*Zoller, B. G.
Zwet, T. van der

SUMMARY

Contact Persons for Fire Blight Newsletter

United States

Arkansas	Slack, D.
California	Zoller, B. G.
Connecticut	Douglas, S. M.
Georgia	Thompson, J. M.
Illinois	Ries, S. M.
Indiana	Janick, J.
Maryland	Steiner, P.
Michigan	Jones, A. L.
Minnesota	
Missouri	Goodman, R. N.
New Jersey	Preiser, F.
New York	Beer, S. V.
North Carolina	Ritchie, D. F.
Ohio	Ellis, M. A.
Oregon	Sugar, D.
Pennsylvania	Hickey, K. D.
South Carolina	Miller, R. W.
Utah	Thomson, S. V.
Virginia	Yoder, K. S.
Washington	Covey, R. P.
West Virginia	Barrat, J. G.
Wisconsin	Wade, E. K.

Canada

Aberta	Evans, I. R.
British Columbia	Sholberg, P.
Nova Scotia	Lockhart, C. L.
Ontario	Bonn, W. G.
Saskatchewan	Stushnoff, C.

Other Countries

Argentina	Meyer, F. C.
Australia	Cartwright, D. N.
Austria	Keck, M.
Belgium	Porreye, W.
China (P.R.)	Cao, R.
Cyprus	Dimova, M.
Czechoslovakia	Kudela, V.
Denmark	Dinesen, A.
Egypt	Abo-El-Dahab, M.K.
England	Garrett, C. M.E.
France	Paulin, J. P.
Germany (East)	Kleinhempel, H.
Germany (West)	Zeller, W.
Greece	Psallidas, P. G.
Hungary	Simon, E.
Ireland	Walsh, P.
Israel	Shabi, E.
Italy	Bazzi, C.
Japan	Fujita, K.
Mexico	Fucikovsky, L.
Morocco	Chouibani, M.
Netherlands	van Teylingen, M.
New Zealand	Hale, C. N.
Norway	Sletten, A.
Poland	Sobiczewski, P.
Portugal	Martins, J. M. S.
Romania	Suta, V.
Russia	Voronkova, L.
South Africa	Hattingh, M. J.
Spain	Noval, C.
Sweden	Graberg, M.
Switzerland	Grimm, R.
Taiwan	Lin, C. P.
Yugoslavia	Stankovic, D.

SUMMARY

Country	Persons Interested in Fire Blight — Interest Category 1	2	3	4	Total	Number of Contact Persons
* USA - United States	33	51		5	89	21
* CND - Canada	5	16			21	5
* BRD - West Germany	8	9	3		20	1
* UK - England	12	4		1	17	1
* BLG - Belgium	11	3			14	1
* NL - Netherlands	5	5		1	11	1
* FR - France	5	4			9	1
* DK - Denmark	1	6			7	1
* DDR - East Germany	1		2		3	1
* NZ - New Zealand	1	1		1	3	1
* EGY - Egypt	2	1			3	1
* MEX - Mexico	1	2			3	1
* GRC - Greece	1	1	1		3	1
* SWD - Sweden		3			3	1
* POL - Poland		1	1		2	1
* ISR - Israel	2				2	1
* NOR - Norway	1	1			2	1
* CYP - Cyprus		1			1	1
* IRL - Ireland		1			1	1
ITA - Italy			10		10	1
SWT - Switzerland			6		6	1
SPN - Spain			6		6	1
JAP - Japan			6		6	1
HUN - Hungary			4		4	1
YUG - Yugoslavia			4		4	1
AUS - Australia			4		4	1
ARG - Argentina			3		3	1
CZE - Czechoslovakia			3		3	1
ROM - Romania			3		3	1
SA - South Africa			3		3	1
POR - Portugal			2		2	1
MOR - Morocco			2		2	1
OST - Austria			2		2	1
CHI - China			2		2	1
RUS - Russia			1		1	1
TAW - Taiwan			1		1	1
BRA - Brazil			2		2	
IND - India			2		2	
TUR - Turkey			1		1	
TOTAL	89	110	74	8	281	60

* Countries with fire blight.

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Fire Blight Mailing List Questionnaire

The list of names in this Newsletter is an annual attempt to establish a complete and updated mailing list of all persons interested in fire blight. Please make corrections and additions where necessary and send me any new names not listed. A new list will be prepared for the next newsletter.

☐ My name, address and telephone are correct (if not, show change below)

☐ My interest in fire blight is correct (if not, please indicate below)

☐ My name should be dropped from this list

☐ My/other name should be added to this list

NAME _____

ADDRESS _____

_____

_____ ZIP

TELEPHONE _____

Interest in fire blight research: 1 2 3 4

Interest in fire blight newsletter: YES NO

I will serve as contact person for newsletter questionnaire: YES NO

} Please circle one of each

_____

Please return to your contact person or directly to:

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Appalachian Fruit Research Station
Route 2, Box 45.
Kearneysville, West Virginia 25430